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CREW APPLIANCE CONCEPTS

CREW APPLIANCE STUDY

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PREFACE

A study of crew appliances for advanced spacecraft is being performed for NASA JSC by the Boeing Aerospace Company under Contract NAS 9-13965. A large number of appliance concepts for the galley, personal hygiene, housekeeping, and other areas have been investigated for application to the Shuttle Orbiter and Modular Space Station missions. This document presents the background to and results of trade studies to determine the optimum appliance systems for these two vehicles.

An index file containing abstracts for 299 appliance-related documents was developed during the initial literature search for this study. The original file will be delivered to and retained by NASA.

Due to the large volume of library references and appliance engineering data used for the trade studies, it was necessary to present the supporting information to the concept report in separate appendices as follows:

APPENDIX A - In this appendix, the complete bibliography used for the appliance study is listed in three forms: numbered, alphabetized, and sorted by subject matter.

APPENDIX B - This appendix contains the supporting engineering data used for all appliance concepts considered for Shuttle Orbiter, including plotted and tabulated trade study results for each appliance function.

<u>APPENDIX C</u> - This appendix contains the supporting engineering data used for all appliance concepts considered for Modular Space Station, including plotted and tabulated trade study results for each appliance function.

ABSTRACT

A review of crew appliance related literature was made to provide background engineering information for development of conceptual appliance systems for the Shuttle Orbiter and the Modular Space Station. From this review, a file containing abstracts of 299 appliance-related documents coded according to subject was developed along with a computerized bibliography of 682 references. Trade studies were conducted using information from these references to determine the optimum concepts to satisfy the Shuttle and Space Station mission requirements. An appliance system was devised for each vehicle which has minimum impact to the respective environmental control system (ECS) with the smallest possible weight, volume, and electrical penalty. Engineering parameters for each appliance concept considered are presented along with the total thermal and electrical loads and weight and volume penalties for each of the optimized appliance systems.

KEY WORDS

Clothes Washer
Crew Appliances
Dishwasher
Food Management
Modular Space Station
Off-Duty Activities
Personal Hygiene
Refuse Management
Shower
Shuttle Orbiter
Spacecraft Environmental Control
Waste Collection

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1.0 INTRODUCTION

The crew appliance study was funded under Contract NAS 9-13965 by the Crew Systems Division of NASA JSC to develop conceptual crew appliance systems which will satisfy the mission requirements for the Shuttle Orbiter and the Modular Space Station.

Major crew appliances generally require large amounts of electrical energy; have high heating or cooling requirements; and are users of liquid/gas consumables. These crew appliance interface requirements can significantly impact the design of a manned space vehicle environmental control and life support system (ECLSS). The objective of this study is to analyze crew appliances to minimize the thermodynamic, power, weight, volume, and utilities support required for the ECLSS using an optimization technique to derive the most efficient mix of appliances. Crew appliance costs were heavily factored in favor of the state-of-the-art concepts; however, all appliance concepts of a sound design were considered during the study.

In order to thoroughly achieve the objectives of the study, all of the available appliance-related reference data were compiled from various library and contractor sources. A review of these references produced a list of documents which were considered most applicable to the appliance functions. These references were categorized and indexed and an abstract of each document written on an index card. The compendium of these index cards has been delivered to NASA JSC and is on file with J. R. Jaax, Building 7.

1.0 (Continued)

A bibliography of all document titles which are pertinent to the crew appliance study was compiled and is attached as Appendix A. The resulting bibliography is ordered by three methods: (1) consecutive reference number, (2) alphabetically, and (3) index codes. The bibliography has been computerized to organize the large number of references and to provide easy retrieval of information. A description of the procedures used to retrieve information from the bibliography using a remote computer terminal is discussed in Appendix A. To facilitate the ease of reference identification in this document, the consecutive numbers of the bibliography were utilized as reference numbers to be used in the text.

Data derived from the referenced documents provided the basis for the appliance concept descriptions contained in Section 3.0. The Crew Appliance System was organized into Habitability Subsystem, Habitability Function, and Appliance Function; and the most feasible concepts were identified for each function. This organization is shown schematically in Figure 1-1. Engineering data derived for each appliance were normalized to the established Shuttle Orbiter and Modular Space Station reference missions. These data were entered into an Appliance Concept Function Matrix to provide direct comparisons of concepts which serve a particular appliance function.

Concepts contained within each Appliance Function were traded using a parameter weighted technique designed to reflect the Shuttle Orbiter and

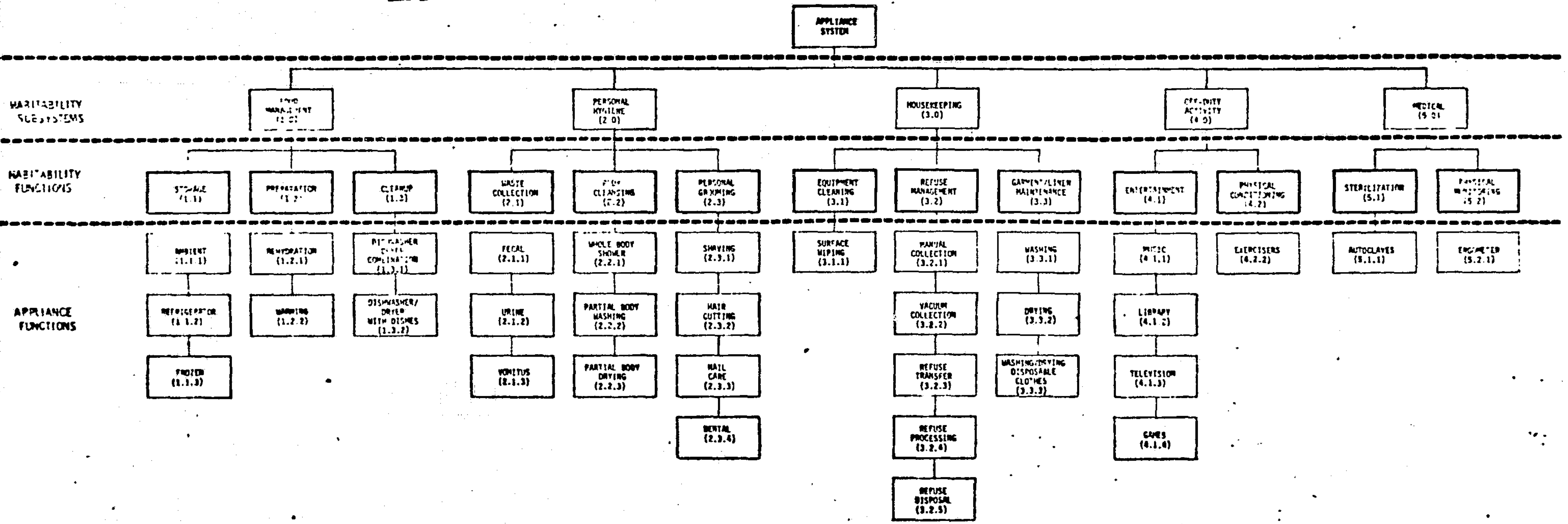


Figure 1-1. Crew Appliance System Organization

1.0 (Continued)

Space Station vehicle appliance requirements. A computer program was developed and used to perform the trade studies. In addition to the concept operational requirements considered, cost, reliability, maintainability, and safety were also factored into the trade program. The advantages of a computerized trade study are rapid turnaround time for parameter changes, changes in weighting distribution, and mission resupply time. The detailed engineering data utilized for the trade studies, the Appliance Concept Function Matrix, and the trade study program results are presented in Appendices B and C. Shuttle Orbiter and Space Station derived appliance requirements and the summary of the appliance function trade study results are located in Sections 4.0 and 5.0, respectively.

Appliance concepts with the highest rating in each of the appliance functions were optimized on a system level as described in Section 6.0. The appliance system optimization study identifies appliance function deficiencies by comparing the top rated concept requirements to the vehicle requirements listed in Section 4.0 and by including crew time, crew preference, and usage time considerations.

The trade program and optimization technique used for this study not only provide the optimized appliance systems for the Shuttle Orbiter and Modular Space Station, but can be used with some manipulation for other vehicle programs. In addition, direct comparisons of appliance systems other than the ones chosen by the study can be readily made utilizing the data presented within these documents.

2.0 SUMMARY

This report documents the concept study phase of the Crew Appliance Study. The main tasks included in the concept study are (1) a literature search to identify space-oriented crew appliance concepts; (2) collect, categorize, and document the available vehicle oriented appliance data; and (3) develop an optimized appliance system for both the Shuttle and Space Station vehicle missions.

The literature search produced an abstract file pertaining to 299 appliance-related documents which were file coded according to subject content. A brief description of each document's contents and its worthiness to the appliance study are included. These documents and 382 others reviewed during the study were compiled to form an appliance subject bibliography. The bibliography, included in this document in Appendix A, has been placed in a computerized format which can be accessed remotely on a time-sharing computer.

Appliance concepts introduced in the literature search and found to be technically reasonable were included in the list of concepts to be reviewed for inclusion in the appliance system. A total of 135 concepts were identified and categorized. All the available engineering parameters relating to the 135 concepts were compiled and summarized in an Appliance Concept Function Matrix. These matrices were constructed for both the Shuttle and Space Station mission operations with the basic appliance functional parameters being adjusted to reflect the mission requirements.

2.0 (Continued)

Various appliance concepts in each habitability function category were traded to determine which concept best satisfied the mission requirements for a particular function. Factors such as weight, volume, electrical power and thermal requirements, reliability, safety, and cost were weighed. The quality of the trade task was enhanced by the use of a Boeing-developed computerized trade routine which easily allowed a variation of weighting factors to be repeatedly assigned and assessed. Concepts which were found in the trade task to best satisfy the Shuttle and Space Station mission requirements are tabulated in Table 2-1 and Table 2-2, respectively.

Appliance concepts identified in the trade program formed the basic optimum appliance system. This system was further optimized by alternating concepts until the conceptual system was within the vehicle requirements or until each requirement deficiency was reduced to a minimum. Final selected concepts for each habitability function in the Shuttle and Space Station appliance systems are tabulated in Table 2-1 and Table 2-2, respectively.

Requirements for the Shuttle Appliance System are sufficiently defined; and the optimized system developed in this study is well within all thermal, electrical, weight and volume requirements. The maximum instantaneous heat rejection load of the optimum system to the Shuttle ECLSS is 464 watts (1583 Btu/hr) less than the specified requirements.

TABLE 2-1
SUMMARY OF SHUTTLE CREW APPLIANCE CONCEPT SELECTION

HABITABILITY SUBSYSTEM	HABITABILITY FUNCTION	APPLIANCE FUNCTION	CONCEPT CHOSEN	FIRST RATED CONCEPT	SECOND RATED CONCEPT
FOOD MANAGEMENT	FOOD STORAGE	REFRIGERATED	Space Radiator	Space Radiator	Thermoelectric
	FOOD PREPARATION	WARMING	Heating Trays	Heating Trays	Convective Oven
	GALLEY CLEANUP	DISH CLEANUP	Reusable Dishes and Utensils with Disposable Wet/Dry Wipes	Reusable Dishes and Utensils with Disposable Wet/Dry Wipes	Reusable Dishes and Disposable Utensils with Disposable Wet/Dry Wipes
PERSONAL HYGIENE	WASTE COLLECTION	FECAL COLLECTION	Dry John System	Apollo System	Skylab System
		URINE COLLECTION		Apollo System	Skylab System
		VOMITUS COLLECTION	Disposable Bags	Disposable Bags	Intimate Adapto
	BODY CLEANSING	PARTIAL BODY WASHING	Disposable Wet Wipe	Disposable Wet Wipe	Skylab-Type Disposable Washcloth
		PARTIAL BODY DRYING	Disposable Dry	Disposable Dry	Electric Dryer
	PERSONAL GROOMING	SHAVING	Safety or Windup	Safety or Windup	Safety or Windup
		DENTAL CARE	Toothbrush w/Dentifrice	Toothbrush w/Dentifrice	Electric Toothbrush
HOUSEKEEPING	EQUIPMENT CLEANUP	SURFACE WIPING	Disposable Wet/Dry Wipes	Disposable Wet/Dry Wipes	Skylab-Type Disposable Cloth
	REFUSE MANAGEMENT	MANUAL COLLECTION	Disposable Trash Bag	Disposable Trash Bag	Disposable Recepticles
		VACUUM COLLECTION	Skylab-Type Electric	Vacuum-Vented	Skylab-Type Electric
		REFUSE DISPOSAL	Storage Bin/Container	Storage Bin/Container	Vacuum Storage
	GARMENT/LINEN MAINTENANCE	CLOTHES WASH/DRY	Disposable Clothes	Disposable Clothes	Mechanical w/Clothes Line
OFF-DUTY ACTIVITIES	ENTERTAINMENT	MUSIC	Cassette Record Recorder	*	*
		LIBRARY	Books	*	*
		TELEVISION	Commercial Type	*	*
		GAMES	Cards, Handball, Etc.	*	*
	PHYSICAL CONDITIONING	EXERCISERS	Exer Gym, Hand Exerciser	*	*

* NOT TRADED

TABLE 2-2

SUMMARY OF SPACE STATION CREW APPLIANCE CONCEPT SELECTION

HABITABILITY SUBSYSTEM	HABITABILITY FUNCTION	APPLIANCE FUNCTION	CONCEPT CHOSEN	FIRST RATED CONCEPT	SECOND RATED CONCEPT
FOOD MANAGEMENT	**FOOD STORAGE**	REFRIGERATED	Space Radiator	Space Radiator	Thermoelectric
		FROZEN	Space Radiator	Space Radiator	Thermoelectric
	FOOD PREPARATION	WARMING	Heating Trays	Heating Trays	Convective Oven
	GALLEY CLEANUP	DISH CLEANUP	Water Spray Wash/Elec. Heat Dry	Reusable Dishes and Disposable Wet/Dry Wipes	Reusable Cups & Dishes - Disposable Utensils and Disposable Wet/Dry Wipes
PERSONAL HYGIENE	**WASTE COLLECTION**	FECAL COLLECTION	Dry John System	Apollo System	Skylab System
		URINE COLLECTION		Apollo System	Skylab System
		VOMITUS COLLECTION	Disposable Bags	Disposable Bags	Intimate Adaptor
	BODY CLEANSING	SHOWER	Collapsible	Collapsible	Mechanical
		PARTIAL BODY WASHING	Reusable Wipes	Reusable Wipes	Skylab-Type Disposable Washcloths
		PARTIAL BODY DRYING	Reusable Wipes	Reusable Wipes	Disposable Dry Wipes
	PERSONAL GROOMING	SHAVING	Windup	Windup	Vacuum Driven
		HAIRCUTTING	Razor Comb Vacuum Collection	Razor Comb Vacuum Collection	Power Clipper Vacuum Collection
		NAIL CARE	Manual Clipper	Manual Clipper	Nail File Vacuum Collection
		DENTAL CARE	Toothbrush w/Dentifrice	Toothbrush w/Dentifrice	Electric Toothbrush
HOUSEKEEPING	EQUIPMENT CLEANUP	SURFACE WIPING	Reusable Wet/Dry Wipes	Disposable Wet/Dry Wipes	Sponge Skylab-Type
	REFUSE MANAGEMENT	MANUAL COLLECTION	Disposable Bags	Disposable Bags	Disposable Recepticles
		VACUUM COLLECTION	Skylab-Type (Electric)	Skylab-Type (Electric)	Vacuum Vented
		REFUSE PROCESSING	Compactor (Air Pressure)	Compactor (Air Pressure)	Compactor (Vacuum)
		REFUSE DISPOSAL	Storage Bin/ Container	Storage Bin/ Container	Vacuum Storage
	GARMENT/LINEN MAINTENANCE	CLOTHES WASH/DRY	Water Spray Agitation Plus Electric Dry	Disposable Clothes	Water Spray Agitation Plus Clothes Line
OFF-DUTY ACTIVITIES	ENTERTAINMENT	MUSIC	Casette Recorder	*	*
		LIBRARY	Books	*	*
		TELEVISION	Commercial Type	*	*
		GAMES	Cards, Handball; Etc.	*	*
	PHYSICAL CONDITIONING	EXERCISERS	Exer Gym, Hand Exerciser	*	*

* NOT TRADED

2.0 (Continued)

Appliance requirements described in the Modular Space Station Study were used for comparison with the optimized Space Station characteristics. Because of insufficient definition of heat rejection and electrical power data in some areas, it was possible only to totally compare weight and volume. The optimized system was selected to provide a balanced system whereby heat rejection and electrical penalties were paid, where necessary, to eliminate high weight and volume-type appliance concepts. The resulting optimized Space Station appliance system is within the weight and volume system requirements (Modular Space Station Study). Maximum instantaneous heat rejection load of the conceptual system to the ECLSS is 1501 watts (5122 Btu/hr) directly to the coolant and 2716 watts (9268 Btu/hr) as heat leakage to the cabin.

3.0 APPLIANCE CONCEPT FUNCTION DESCRIPTION

An Appliance Concept Function Matrix was developed to describe the physical and operational parameters for each appliance concept. Formatting of the matrix was designed to include and properly present parameters which have an impact on a vehicle ECLSS. Appliance concepts included in the matrices were organized within an appliance system to facilitate indexing of each concept. Appliance concept data presented in the matrices were adjusted to reflect Shuttle Orbiter and Modular Space Station mission requirements. The Shuttle Orbiter and Modular Space Station baseline mission and timeline were developed using the latest available reference data.

3.1 MISSION BASELINE DESCRIPTION

Shuttle Orbiter and Modular Space Station baseline missions are presented in Figures 3-1 and 3-2, respectively. Mission timelines for the two spacecraft are shown in Figures 3-3 and 3-4. The Shuttle Orbiter mission baseline was referenced from the 1973 fourth quarter Rockwell International mission description (Reference 32). The Modular Space Station mission baseline was compiled from McDonnell Douglas, Rockwell International, Hamilton Standard, and NASA JSC study reports.

The Shuttle Orbiter baseline mission provides for a maximum of six crewmembers for 7 days. Vehicle capability must, however, be based on the nominal mission plus contingencies in order to specify a complete appliance concept. Shuttle Orbiter contingency is specified as 96 hours for up to 10 crewmen. The appliance study was, therefore, based on a 42 man-days nominal mission

SHUTTLE MISSION BASELINE

- o 150,000 POUND ORBITER
- o BASELINE MISSION
    - 42 MAN-DAYS (3-6 MALE/FEMALE CREW FOR 7 DAYS)
    - 4 MAN NOMINAL MISSION
- o VEHICLE SYSTEM CAPABILITY
    - 42 MAN-DAYS + 96-HOUR CONTINGENCY FOR UP TO 10 CREWMEN (40 MAN-DAYS)

SHUTTLE IMPOSED REQUIREMENTS ON THE APPLIANCE SYSTEM

- o ALL MISSIONS WILL USE SAME HABITABILITY FUNCTIONS
- o GRAVITY - ZERO TO ONE EARTH GRAVITY
- o ATMOSPHERE
    - PRESSURE 14.7 PSIA
    - COMPOSITION 3.2 PSIA O_2
11.5 PSIA N_2
    - CO_2 CONCENTRATION 0-7.6 mm Hg
- o TEMPERATURE
    - RANGE (DRY BULK) 65°-80°F
        - 4 MEN (DESIGN PT.) 70°F
        - 10 MEN (DESIGN PT.) 80°F
    - DEWPOINT 39°-61°F
- o OPERATIONAL LIFE
    - 10 YEARS/100 ORBITAL MISSIONS/REPLACEABLE UNIT CONCEPT
- o GENERAL
    - GAS VENTING ALLOWED/NONPROPULSIVE
    - LIQUID VENTING SHALL BE MINIMIZED/NONPROPULSIVE
    - JETTISON OF SOLIDS/SOLID WASTES SHALL NOT BE ALLOWED.
    - NO MEDICAL SAMPLING REQUIRED OF FECES/URINE

SHUTTLE TIMELINE

- o NOMINAL CREW TIMELINE (SEE FIGURE A-1)
    - WORK (INCLUDING OFF-DUTY) - 13 HOURS
    - EAT - 3 HOURS
    - SLEEP - 8 HOURS

REFERENCE MSC 07896, "SPACE SHUTTLE SYSTEM BASELINE REFERENCE MISSIONS-VOLUME II"

Figure 3-1. Shuttle Baseline Mission

SPACE STATION MISSION BASELINE

- 20,000 POUND MODULES (MAXIMUM)
- BASELINE MISSION
  - 6-MAN CREW (MALE/FEMALE)
  - 90/180-DAY RESUPPLY
- VEHICLE SYSTEM CAPABILITY
  - 1080 MAN-DAYS + 96 HOUR CONTINGENCY FOR UP TO 12 MEN

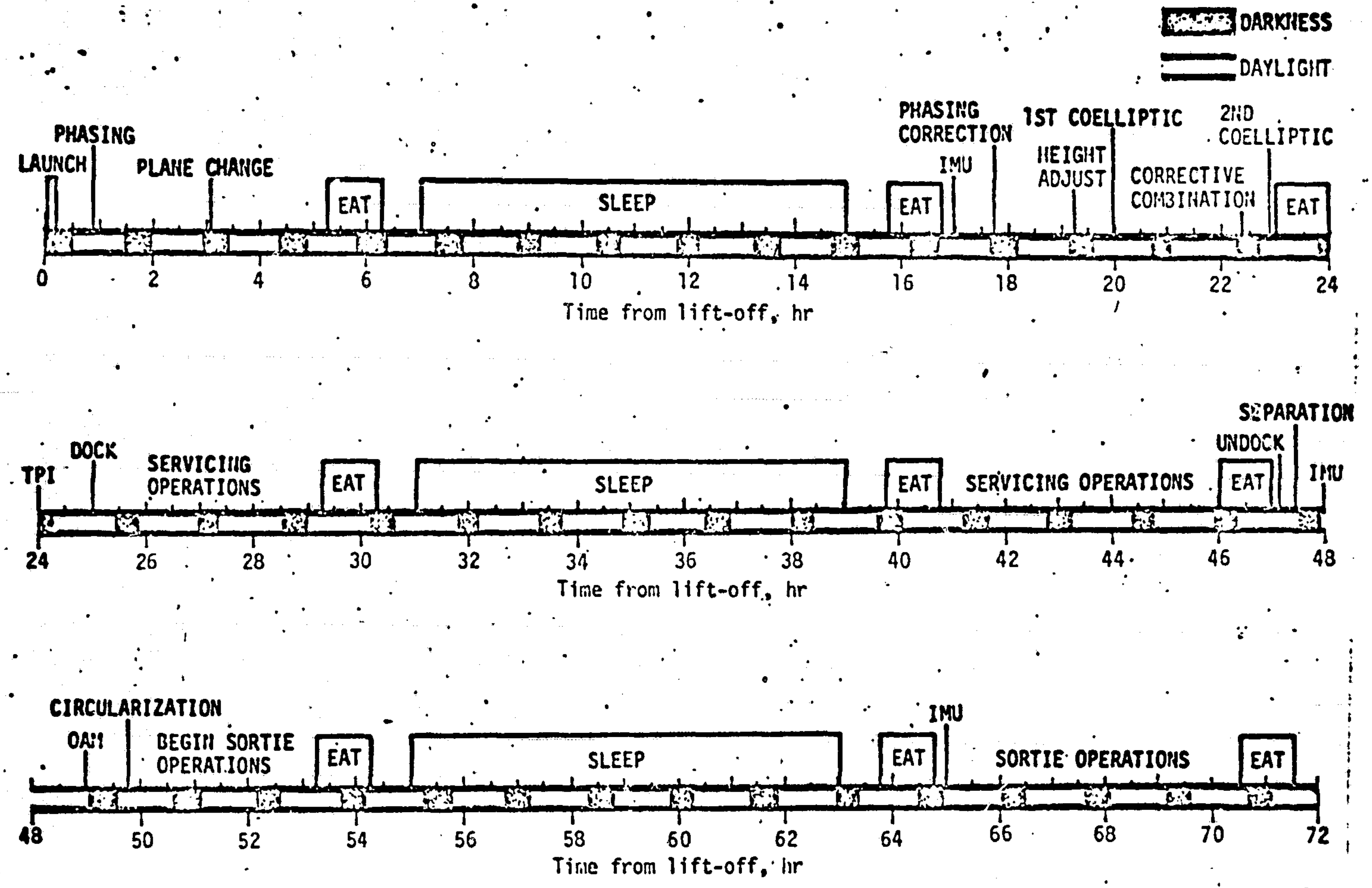
SPACE STATION REQUIREMENTS IMPOSED ON THE APPLIANCE SYSTEM

- GRAVITY - ZERO
- ATMOSPHERE (LIVING QTR's)
  - PRESSURE 14.7 PSIA
  - COMPOSITION 3.2 PSIA O_2
11.5 PSIA N_2
  - CO_2 CONCENTRATION
- TEMPERATURE (LIVING QTR's)
  - RANGE (DRY BULK) 65° -75° F
  - DEWPOINT 39° -62° F
- OPERATIONAL LIFE
  - 10 YEARS/SCHEDULED MAINTENANCE
- GENERAL
  - GAS VENTING ALLOWED/NONPROPULSIVE
  - LIQUID VENTING SHALL BE MINIMIZED/NONPROPULSIVE
  - JETTISON OF SOLIDS/SOLID WASTES SHALL NOT BE ALLOWED

SPACE STATION TIMELINE

- NOMINAL CREW DUTY CYCLE
  - SEE FIGURE A-2

Figure 3-2. Space Station Baseline Mission



(a) Launch to 72 hours.

Figure 3-3. Shuttle Orbiter Timeline

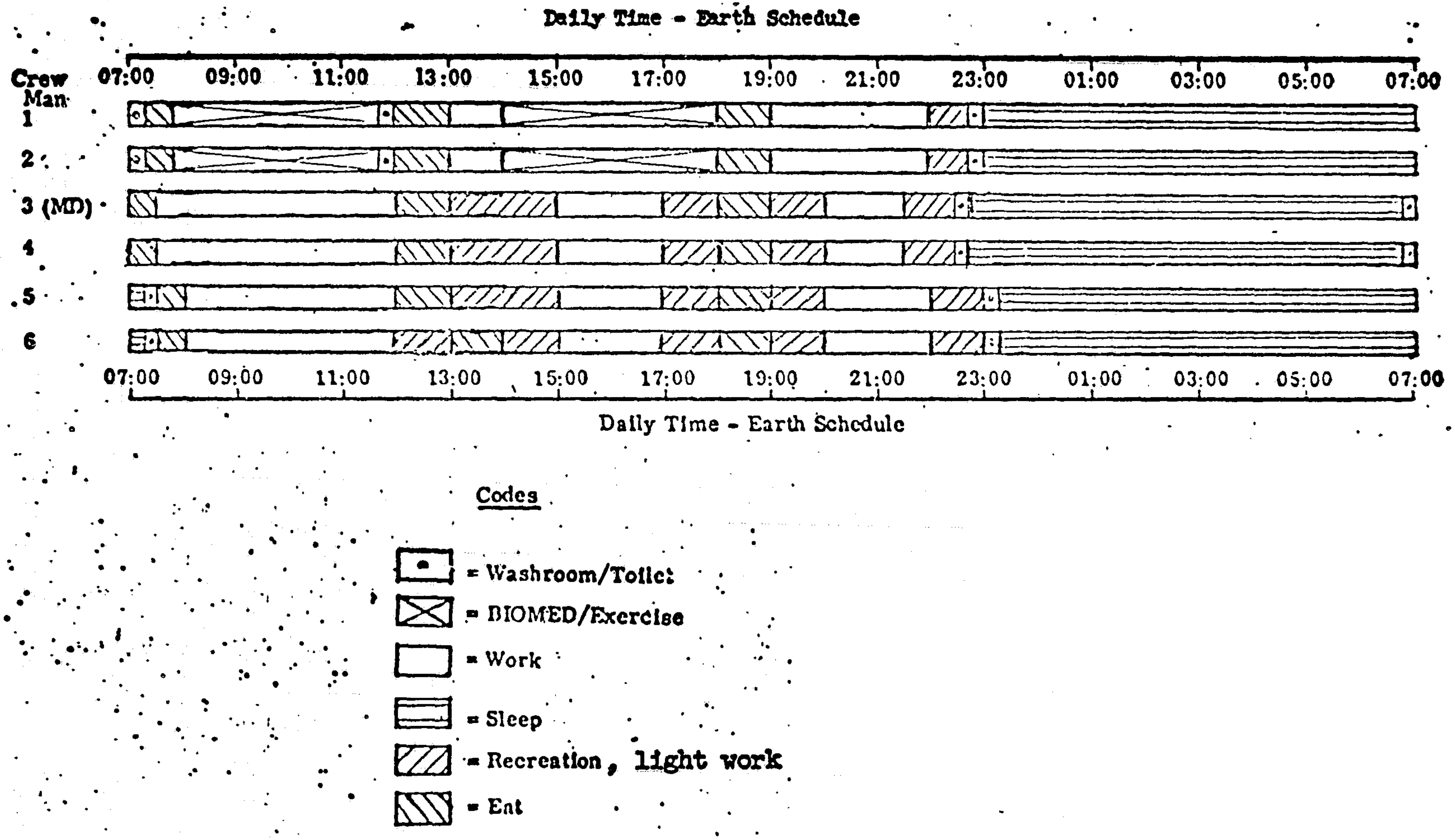


Figure 3-4. Space Station Timeline

3.1 (Continued)

plus 40 man-days contingency or 82 man-days (20.5 days with a nominal four-man crew). The timeline used as a baseline for daily crew activity was based on the mission requirements (Reference 32).

The Modular Space Station baseline mission uses a nominal six-man crew for 180 days. Mission contingency is based on 96 hours for six men. A total vehicle capability of 1104 man-days or 184 days was used for the appliance study. Space Station resupply period was assumed to be 180 days. The timeline used as a baseline for daily crew activity was based on the mission requirements and was taken from Reference 273. This timeline will be modified as required to incorporate the various appliance functions involving crew time in the Crew Appliance System Optimization section of this report. Also, timelines will be altered to reduce the appliance system peak thermal and power demands on the vehicle systems.

In addition to the ECLSS imposed appliance restrictions, liquid and gas venting from appliances was minimized or eliminated and jettison of solids/solid wastes was not allowed. Gas or liquid venting, when allowed, was assumed to be nonpropulsive. The Shuttle Orbiter personal hygiene appliance concepts do not include hardware required to provide medical sampling of crewman feces/urine.

3.2 APPLIANCE SYSTEM DESCRIPTION

Development of a crew appliance system organization was necessary to thoroughly and orderly categorize all of the appliance concepts. The system organization is summarized in Figure 1-1. The Crew Appliance System was subdivided into three major groupings: Habitability Subsystem, Habitability Function, and Appliance Function. The five habitability subsystems are food management, personal hygiene, housekeeping, off-duty activity, and medical. These subsystems were further subdivided into 13 crew habitability functions and appliance functions then identified for each. A total of 33 appliance functions were included in the study.

Engineering data were derived for each concept listed in the Appliance Function section using the reference data described in Paragraph 2.0, NASA JSC and JSFC personnel, and crew appliance/space vehicle contractors. New concepts were also added as they were identified during the study. A total of 135 individual appliance concepts considered during the study are listed in Figure 3-5 by title.

Appliance concept engineering data were normalized to the Shuttle Orbiter and Modular Space Station baseline mission requirements. These data were arranged and are presented in Appendices B and C by individual appliance concept descriptions and work sheets. Appendices B and C apply to Shuttle Orbiter and Modular Space Station, respectively. The work sheets provide identification of each crew appliance concept weight, volume, electrical power, and thermal requirements.

1.0 FOOD MANAGEMENT

1.1 FOOD STORAGE

1.1.1 Ambient Food Storage

1.1.1.1 Rigid Containers
1.1.1.2 Flexible Containers

1.1.2 Refrigerated Food Storage

1.1.2.1 Space Radiator
1.1.2.2 Thermoelectric
1.1.2.3 Air Cycle Turbine/Compressor

1.1.3 Frozen Food Storage

1.1.3.1 Space Radiator
1.1.3.2 Thermoelectric
1.1.3.3 Air Cycle Turbine/Compressor

1.2 FOOD PREPARATION

1.2.1 Food Rehydration

1.2.2 Food Warming

1.2.2.1 Heating Trays (Skylab)
1.2.2.2 Oven - Hot Air Convention (Electric Heat)
1.2.2.3 Oven - Microwave

1.3 GALLEY CLEANUP

1.3.1 Dishwasher/Dryer Combination

1.3.1.1 Hot Water Spray - Centrifuge Drying
1.3.1.2 Hot Water Spray - Air Spray Dry
1.3.1.3 Hot Water Spray Wash - Force Hot Air Electric Heat Dry
1.3.1.4 Hot Water Spray Wash - Forced Cold Air Desiccant
1.3.1.5 Hot Water Spray Wash - Forced Hot Air Dry - Thermal Storage
1.3.1.6 Ultrasonic Wash - Centrifuge Drying
1.3.1.7 Ultrasonic Wash - Forced Hot Air Electric Dry
1.3.1.8 Ultrasonic Wash - Force Cold Dry Air - Desiccant, Electrically Desorbed
1.3.1.9 Ultrasonic Wash - Force Hot Air Dry - Thermal Storage
1.3.1.10 Manual Wash - Manual Wipe Dry

1.3.2 Dishwasher/Dryer with Dishes

1.3.2.1 Hot Water Spray - Centrifuge Drying
1.3.2.2 Hot Water Spray - Forced Hot Air Electric Heat Drying
1.3.2.3 Hot Water Spray - Forced Air/Desiccant/ Electrically Heated
1.3.2.4 Manual Wash - Manual Wipe
1.3.2.5 Disposable Cups - Reusable Metallic Utensils and Dishes
1.3.2.6 Disposable Cups and Nonmetallic Dishes - Reusable Metallic Utensils
1.3.2.7 Disposable Cups and Nonmetallic Utensils - Reusable Metallic Dishes
1.3.2.8 Disposable Cups and Nonmetallic Utensils and Dishes
1.3.2.9 Reusable Cups and Metallic Utensils and Dishes
1.3.2.10 Reusable Cups and Metallic Utensils - Disposable Nonmetallic Dishes
1.3.2.11 Reusable Cups and Metallic Dishes - Disposable Nonmetallic Utensils
1.3.2.12 Reusable Cups-Disposable Nonmetallic Utensils and Dishes

2.0 PERSONAL HYGIENE

2.1 WASTE COLLECTION/TRANSFER

2.1.1 Fecal Collection/Transfer

Figure 3-5. Crew Habitability and Appliance Functions and Concepts

2.1.1.1 Dry John
2.1.1.2 Dry John - Anal Wash
2.1.1.3 Germicide - Wet John
2.1.1.4 Integrated Vacuum Decomposition
2.1.1.5 Flush Flow O_2 Incineration
2.1.1.6 Pyrolysis/Batch Incineration
2.1.1.7 Wet Oxidation
2.1.1.8 Semiautomatic Bag System (Skylab)
2.1.1.9 Dry Bags (Apollo)

2.1.2 Urine Collection/Transfer

2.1.2.1 Standup Urinal
2.1.2.2 Commode Urinal
2.1.2.3 Intimate Male Adapter Urine (Skylab)
2.1.2.4 Aperture Urinal
2.1.2.5 Liquid/Gas Flow Cuff Type (Apollo)

2.1.3 Vomitus Collection/Transfer

2.1.3.1 Disposable Intimate Personal Adapter (Mates with Commode)
2.1.3.2 Reusable Intimate Personal Adapter, Lined (Mates with Commode)
2.1.3.3 Disposable Portable Collector
2.1.3.4 Reusable Portable Collector

2.2 BODY CLEANSING

2.2.1 Whole Body Shower

2.2.1.1 Vacuum Pickup
2.2.1.2 Air Drag (Evaporative)
2.2.1.3 Mechanical (Towel Pickup)
2.2.1.4 Collapsible

2.2.2 Partial Body Washing

2.2.2.1 Disposable Wet Wipes
2.2.2.2 Reusable Wet Wipes
2.2.2.3 Disposable Wipes (Prepackaged)
2.2.2.4 Automatic Sponge
2.2.2.5 Reusable Washcloths
2.2.2.6 Disposable Washcloths (Skylab)

2.2.3 Partial Body Drying

2.2.3.1 Reusable Dry Wipes
2.2.3.2 Disposable Dry Wipes
2.2.3.3 Electric Dryer

2.3 PERSONAL GROOMING

2.3.1 Shaving

2.3.1.1 Wet Shave - Safety Razor and Cream
2.3.1.2 Dry Shave - Electric Razor/Vacuum Collection
2.3.1.3 Dry Shave - Windup Razor (Skylab)
2.3.1.4 Dry Shave - Vacuum Motor-Driven Razor
2.3.1.5 Wet Shave - Safety Razor/Vacuum Collection

2.3.2 Hair Cutting

2.3.2.1 Electric Clipper/Vacuum Collection
2.3.2.2 Razor-Comb/Vacuum Collection

2.3.3 Nail Care

2.3.3.1 Manual Nail Clipper/Bag Collection
2.3.3.2 Metal Nail File/Vacuum Collection

2.3.4 Dental

2.3.4.1 Toothbrush with Dentifrice
2.3.4.2 Water Pix
2.3.4.3 Electric Toothbrush with Dentifrice

3.0 HOUSEKEEPING

3.1 EQUIPMENT CLEANING

3.1.1 Surface Wiping

3.1.1.1 Disposable Wet/Dry Wipes

Figure 3-5. Crew Habitability and Appliance Functions and Concepts (continued)

3.1.1.2 Reusable Wet/Disposable Dry Wipes
3.1.1.3 Disposable Wet/Dry Wipes (Prepackaged)
3.1.1.4 Automatic Mop
3.1.1.5 Reusable Cleaning Cloths/ Disposable Dry Wipes
3.1.1.6 Disposable Cleaning Cloths/Disposable Dry Wipes
3.1.1.7 Disposable Wet Wipes/Reusable Dry Wipes
3.1.1.8 Reusable Wet/Dry Wipes
3.1.1.9 Reusable Cleaning Cloths/Dry Wipes
3.1.1.10 Disposable Cleaning Cloths/Reusable Dry Wipes
3.1.1.11 Sponges
3.1.1.12 Sponges/Skylab Wetting Unit

3.2 REFUSE MANAGEMENT

3.2.1 Manual Collection

3.2.1.1 Waste/Trash Bags
3.2.1.2 Waste Receptacles/Reusable
3.2.1.3 Waste Receptacles/Disposable

3.2.2 Vacuum Collection

3.2.2.1 Portable Vacuum/Electric (Skylab)
3.2.2.2 Portable Vacuum/Electric (Commercial)
3.2.2.3 Portable Vacuum/Space Venting

3.2.3 Refuse Transfer

3.2.4 Refuse Processing

3.2.4.1 Compactor
3.2.4.2 Shredder
3.2.4.3 Incinerator
3.2.4.4 Integrated Vacuum Decomposition
3.2.4.5 Flush Flow O_2 Incineration
3.2.4.6 Pyrolysis/Batch Incineration
3.2.4.7 Wet Oxidation

3.2.5 Refuse Disposal/Storage

3.2.5.1 Vacuum Storage
3.2.5.2 Storage Bin/Container
3.2.5.3 Restorage/Biological Stabilized
3.2.5.4 Trash Rocket

3.3 GARMENT/LINEN MAINTENANCE

3.3.1 Garment/Linen Washing

3.3.1.1 Mechanical Oscillations
3.3.1.2 Fluidic Agitation
3.3.1.3 Piston Agitation
3.3.1.4 Cyclic Valve and Pump
3.3.1.5 Diaphragm Actuated - One Directional Squeeze
3.3.1.6 Diaphragm Actuated - Two Directional Squeeze
3.3.1.7 Water Spray Agitated
3.3.1.8 Ultrasonic
3.3.1.9 Manual Washboard
3.3.1.10 Plain Recirculation

3.3.2 Garment/Linen/Drying

3.3.2.1 Forced Hot Air - Electric
3.3.2.2 Forced Hot Air - Heat from Thermal Storage Unit
3.3.2.3 Force Cold Dry Air - Desiccant - Vacuum Regenerable
3.3.2.4 Force Cold Dry Air - Desiccant - Heat Regenerable
3.3.2.5 Vacuum Dry
3.3.2.6 Thermal Vacuum Dry - Electric Heat
3.3.2.7 Thermal Vacuum Dry - Thermal Storage/Radiant Heat
3.3.2.8 Clothesline - Forced Convection
3.3.2.9 Clothesline - Forced Convection plus Electric Heat

3.3.3 Garment/Linen Washer/Dryer-Disposable Clothes

3.3.3.1 Fluidic Agitation/Forced Hot Air - Electric Heater

Figure 3-5. Crew Habitability and Appliance Functions and Concepts (continued)

3.3.3.2 Fluidic Agitation/Forced Hot Air - Thermal Storage Heated
3.3.3.3 Fluidic Agitation/Forced Air Drying - Clothesline
3.3.3.4 Fluidic Agitation/Forced Air Drying - Clothesline
3.3.3.5 Water Spray Agitation/Forced Hot Air - Electric Heater
3.3.3.6 Water Spray Agitation/Forced Hot Air - Thermal Storage Heater
3.3.3.7 Water Spray Agitation/Forced Air Drying - Clothesline
3.3.3.8 Water Spray Agitation/Electrically Heated - Clothesline
3.3.3.9 Disposable Clothes

3.4 WASH WATER PROCESSING

4.0 OFF-DUTY ACTIVITIES

4.1 ENTERTAINMENT

4.1.1 Music

4.1.1.1 Cassette Player/Recorder

4.1.2 Library

4.1.2.1 Books

4.1.3 Television

4.1.4 Games

4.1.4.1 Handball
4.1.4.2 Dart Board
4.1.4.3 Cards

4.2 PHYSICAL CONDITIONING

4.2.1 Exer-gym

4.2.2 Hand Exerciser

5.0 MEDICAL

5.1 STERILIZATION

5.1.1 Autoclaves

5.1.1.1 Moist Heat
5.1.1.2 Dry Heat
5.1.1.3 Ethylene Oxide

5.2 PHYSICAL MONITORING

5.2.1 Ergometer

Figure 3-5. Crew Habitability and Appliance Functions and Concepts (concluded)

3.2 (Continued)

In addition to these basic data, the solid/gas/liquid expendables requirements and operational penalties, if applicable, were computed and are also presented in the work sheets. A schematic or outline drawing, in most cases, and a summary of the references from which the engineering data were derived accompany each concept description.

3.3 APPLIANCE CONCEPT FUNCTION MATRIX

Engineering data derived for each appliance concept described in Paragraph 3.2 were formulated into an Appliance Concept Function Matrix. The results of these concept analyses are summarized, by appliance function, in the matrices included in Tables 3-1 through 3-29 for Shuttle and Tables 3-30 through 3-59 for Space Station.

The Appliance Concept Function Matrix was developed, organized, and compiled to completely assess each concept's impact on the space vehicle mission operation and particularly on the vehicle ECLSS and to provide the necessary data for trade studies.

The matrix identifies the appliance concepts in the first column. Usage time is specified in uses per day and hours per use in order to provide rate data for future work. The consumables and flow requirements columns specify the type of fluid, amount consumed per use, flow rate, pressure, and temperature required of the ECLSS by the appliance concept. Thermal requirements are divided into coolant and heat leak requirements for use

3.3 (Continued)

in estimating the appliance concept impact on ECLSS thermal designs. The coolant thermal requirement was defined as latent and sensible heat required to be removed at an appliance/ECLSS coolant interface. Heat leak thermal requirement is the latent and sensible heat required to be removed at the ECLSS cabin heat exchanger. The electrical power requirements identify the peak and average AC and DC power requirements for each appliance concept. These data can be used to aid the selection of a vehicle power system including inverters. Weight and volume requirements specify the total weight and volume for each appliance concept including its solid, liquid, and gas expendables requirements which are mission dependent. Development cost is specified by the appliance concept availability; i.e., available, state of the art, etc., and cost indicator which is based on the appliance concept complexity. A detailed explanation of the development cost analysis is contained in Paragraph 5.1.1. The resupply column applies only to the Modular Space Station. Resupply is the consumable weight necessary for the appliances to function for an additional 180 days. The remainder of the data in the matrix described previously are based on the referenced mission of 184 days for Space Station and 20.5 days for the Shuttle Orbiter.

The matrix for each appliance function with its accompanying set of concept descriptions and work sheets, located in Appendices B and C, provide a complete background for the derived appliance data. These data were used as the basis for the trade studies (Paragraph 5.0) conducted during the crew appliance study.

TABLE 3-1

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 1.1.1 .... AMBIENT FOOD STORAGE (SHUTTLE)

CONCEPT NO.	USAGE TIME USES/DAY HRS/USE	CONSUMABLES AND FLOW REQUIREMENTS TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	THERMAL REQMTS COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	ELEC PWR REQMTS PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WT/VOL REQMTS WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	DEVELOPMENT COST AVAIL (**)	INDEX (***)	RESUPPLY WEIGHT -KG- (LBS)
1	.000 .000						0. (0.)	0. (0.)	.0 .0	.0 .0	7.1 (15.6)	.79 (27.90)	1	0	.0 (.0)
2	.000 .000						0. (0.)	0. (0.)	.0 .0	.0 .0	.0 (1.6)	.00 (20.30)	1	10	.0 (.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1	RIGID
2	FLEXIBLE

(*)

1 -	CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 -	CABIN AIR	(LOST) ,	KG/HR	(LB/HR)
3 -	OXYGEN	(LOST) ,	KG/HR	(LB/HR)
4 -	COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 -	WATER	(LOST) ,	KG/HR	(LB/HR)
6 -	NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 -	NITROGEN	(USED) ,	KG/HR	(LB/HR)
8 -	FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 -	WATER	(PROCESSED) ,	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-2

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 1.1.2 .... REFRIGERATED FOOD STORAGE (SHUTTLE)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -AATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	.000 .000	8	.0000 (.0000)	.00 (.00)	.0 (.0)	4.4 (40.0)	9. (30.)	41. (141.)	50.0 .0	.0 .0	8.9 (19.6)	.09 (1.44)	1	0	.0 (.0)
2	.000 .000						68. (233.)	14. (48.)	.0 100.0	.0 .0	14.1 (31.0)	.10 (3.40)	2	25	.0 (.0)
3	.000 .000						373. (1274.)	1060. (3620.)	10200.0 .0	.0 .0	72.6 (160.0)	1.19 (42.00)	3	70	.0 (.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	SPACE RADIATOR
2 -	THERMOELECTRIC
3 -	AIR CYCLE-TURBINE/COMPRESSOR

(*)

1 -	CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 -	CABIN AIR	(LOST) ,	KG/HR	(LB/HR)
3 -	OXYGEN	(LOST) ,	KG/HR	(LB/HR)
4 -	COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 -	WATER	(LOST) ,	KG/HR	(LB/HR)
6 -	NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 -	NITROGEN	(USED) ,	KG/HR	(LB/HR)
8 -	FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 -	WATER	(PROCESSED) ,	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

ok

TABLE 3-3

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 1.1.3 •••• FROZEN FOOD STORAGE (SHUTTLE)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	.000 .000	8	.0000 (.0000)	.00 (.00)	.0 (.0)	-23.3 (-10.0)	55. (188.)	-5. (-17.)	50.0 .0	.0 .0	44.8 (98.7)	.21 (7.25)	1	0	.0 (.0)
2	.000 .000						389. (1327.)	78. (268.)	.0 570.0	.0 .0	96.2 (212.0)	.39 (13.80)	2	25	.0 (.0)
3	.000 .000						2328. (7950.)	1540. (5260.)	15200.0 .0	.0 .0	328.0 (723.0)	3.82 (135.00)	3	70	.0 (.0)

APPLIANCE CONCEPT NO. CONCEPT NAME

1 - SPACE RADIATOR
2 - THERMOELECTRIC
3 - AIR CYCLE-TURBINE/COMPRESSOR

(*)
1 - CABIN AIR (CIRCULATED), LITERS/SEC (FT^3/MIN)
2 - CABIN AIR (LOST) , KG/HR (LB/HR)
3 - OXYGEN (LOST) , KG/HR (LB/HR)
4 - COOLING WATER (CIRCULATED), KG/HR (LB/HR)
5 - WATER (LOST) , KG/HR (LB/HR)
6 - NITROGEN (CIRCULATED), KG/HR (LB/HR)
7 - NITROGEN (USED) , KG/HR (LB/HR)
8 - FREON (CIRCULATED), KG/HR (LB/HR)
9 - WATER (PROCESSED) , KG/HR (LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-4

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 1.2.2 .... FOOD WARMING (SHUTTLE)

CONCEPT NO.	USAGE TIME USES/DAY HRS/USE	CONSUMABLES AND FLOW REQUIREMENTS TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	THERMAL REQMTS COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	ELEC PWR REQMTS PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WT/VOL REQMTS WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	DEVELOPMENT COST AVAIL (**)	INDEX (***)	RESUPPLY WEIGHT -KG- (LBS)
1	3.000						0.	197.	.0	.0	36.6	.14	1	5	.0
	2.000						(0.)	(672.)	660.0	197.0	(80.6)	(4.80)			(.0)
2	3.000						0.	343.	.0	.0	24.6	.11	2	30	.0
	.500						(0.)	(1170.)	858.0	686.0	(54.3)	(3.90)			(.0)
3	3.000						0.	685.	2745.0	2745.0	37.6	.13	2	30	.0
	.167						(0.)	(2340.)	.0	.0	(82.9)	(4.70)			(.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1	HEATING TRAYS (SKYLAB)
2	OVEN-HOT AIR CONVECTION (ELECTRICAL HEAT)
3	OVEN-MICROWAVE (PLAIN)

ORIGINAL PAGE IS
OF POOR QUALITY

(*)

1 - CABIN AIR (CIRCULATED), LITERS/SEC (FT^3/MIN)
2 - CABIN AIR (LOST) , KG/HR (LB/HR)
3 - OXYGEN (LOST) , KG/HR (LB/HR)
4 - COOLING WATER (CIRCULATED), KG/HR (LB/HR)
5 - WATER (LOST) , KG/HR (LB/HR)
6 - NITROGEN (CIRCULATED), KG/HR (LB/HR)
7 - NITROGEN (USED) , KG/HR (LB/HR)
8 - FREON (CIRCULATED), KG/HR (LB/HR)
9 - WATER (PROCESSED) , KG/HR (LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-5

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 1.3.1 •••• DISH WASHER/DRYER COMBINATION (SHUTTLE)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	3.000	9	9.0720	.00	.0	.0	0.	247.	100.0	.0	321.6	.48	3	65	.0
	2.000		(20.0000)	(.00)	(.0)	(.0)	(0.)	(845.)	50.0	.0	(709.0)	(16.90)			(.0)
2	3.000	9	9.0720	.00	.0	.0	0.	900.	900.0	.0	319.5	.52	3	60	.0
	2.000		(20.0000)	(.00)	(.0)	(.0)	(0.)	(3075.)	50.0	.0	(704.3)	(18.20)			(.0)
3	3.000	9	9.0720	.00	.0	.0	164.	247.	111.0	.0	328.0	.48	3	50	.0
	2.000		(20.0000)	(.00)	(.0)	(.0)	(561.)	(845.)	217.0	.0	(723.0)	(16.90)			(.0)
4	3.000	9	9.0720	.00	.0	.0	65.	246.	116.0	.0	325.5	.52	3	75	.0
	2.000		(20.0000)	(.00)	(.0)	(.0)	(221.)	(839.)	97.0	.0	(717.7)	(18.50)			(.0)
5	3.000	9	9.0720	.00	.0	.0	262.	170.	124.0	.0	338.4	.51	3	75	.0
	2.000		(20.0000)	(.00)	(.0)	(.0)	(895.)	(581.)	48.0	.0	(746.0)	(17.90)			(.0)
6	3.000	9	9.0720	.00	.0	.0	0.	412.	167.0	.0	328.5	.50	3	70	.0
	2.000		(20.0000)	(.00)	(.0)	(.0)	(0.)	(1407.)	49.0	.0	(724.3)	(17.50)			(.0)
7	3.000	9	9.0720	.00	.0	.0	161.	414.	167.0	.0	332.5	.51	3	65	.0
	2.000		(20.0000)	(.00)	(.0)	(.0)	(551.)	(1414.)	217.0	.0	(733.0)	(17.90)			(.0)
8	3.000	9	9.0720	.00	.0	.0	65.	451.	167.0	.0	331.1	.54	3	75	.0
	2.000		(20.0000)	(.00)	(.0)	(.0)	(221.)	(1541.)	97.0	.0	(730.0)	(19.20)			(.0)
9	3.000	9	9.0720	.00	.0	.0	263.	170.	167.0	.0	345.2	.52	3	75	.0
	2.000		(20.0000)	(.00)	(.0)	(.0)	(898.)	(581.)	48.0	.0	(761.0)	(18.50)			(.0)
10	3.000	9	9.0720	.00	.0	.0	40.	234.	14.7	.0	305.9	.30	2	35	.0
	2.000		(20.0000)	(.00)	(.0)	(.0)	(135.)	(800.)	45.0	.0	(674.3)	(10.70)			(.0)

ok

TABLE 3-5 (concluded)

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	-	HOT WATER SPRAY-CENTRIFUGE DRYING
2	-	HOT WATER SPRAY-AIR SPRAY DRY
3	-	HOT WATER SPRAY-FORCED HOT AIR ELECTRIC HEAT DRY
4	-	HOT WATER SPRAY-DESICCANT ELECTRICALLY DESORBED
5	-	HOT WATER SPRAY-FORCED HOT AIR DRY-THERMAL STORAGE
6	-	ULTRASONIC WASH-CENTRIFUGE DRYING
7	-	ULTRASONIC WASH-FORCRD HOT AIR DRYING
8	-	ULTRASONIC WASH-FORCED COLD DRY AIR-DESICCANT, ELECTRICALLY DESORBED
9	-	ULTRASONIC WASH-FORCED HOT AIR DRY-THERMAL STORAGE
10	-	MANUAL WASH-MANUAL WIPE DRY

(*)

1 -	CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 -	CABIN AIR	(LOST),	KG/HR	(LB/HR)
3 -	OXYGEN	(LOST),	KG/HR	(LB/HR)
4 -	COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 -	WATER	(LOST),	KG/HR	(LB/HR)
6 -	NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 -	NITROGEN	(USED),	KG/HR	(LB/HR)
8 -	FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 -	WATER	(PROCESSED),	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-6

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 1.3.2 •••• DISH WASHER/DRYER WITH DISPOSABLES - SHUTTLE

CONCEPT NO.	USAGE TIME USES/DAY HRS/USE	CONSUMABLES AND FLOW REQUIREMENTS TYPE (•)	AMT. USED -KG/USE- (LB/USE)	FLOW • (•)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	THERMAL REQMTS COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	ELEC PWR REQMTS PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WT/VOL REQMTS WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	DEVELOPMENT COST AVAIL (••)	INDEX (•••)	RESUPPLY WEIGHT -KG- (LBS)
1	3.000 2.000	9	9.0720 (20.0000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	247. (845.)	100.0 50.0	.0 .0	321.6 (709.0)	.48 (16.90)	3	65	.0 (.0)
2	3.000 2.000	9	9.0720 (20.0000)	.30 (.30)	.0 (.0)	.0 (.0)	164. (561.)	247. (845.)	111.0 217.0	.0 .0	328.0 (723.0)	.48 (16.90)	3	50	.0 (.0)
3	3.000 2.000	9	9.0720 (20.0000)	.00 (.00)	.0 (.0)	.0 (.0)	65. (221.)	246. (839.)	116.0 108.0	.0 .0	325.5 (717.7)	.52 (18.50)	3	75	.0 (.0)
4	3.000 2.000	9	9.0720 (20.0000)	.00 (.00)	.0 (.0)	.0 (.0)	40. (135.)	234. (800.)	14.7 45.0	.0 .0	305.9 (674.3)	.30 (10.70)	2	35	.0 (.0)
5	3.000 .333						0. (0.)	0. (0.)	.0 .0	.0 .0	20.3 (44.7)	.19 (6.70)	1	10	.0 (.0)
6	3.000 .333						0. (0.)	0. (0.)	.0 .0	.0 .0	20.7 (45.7)	.46 (16.40)	1	10	.0 (.0)
7	3.000 .333						0. (0.)	0. (0.)	.0 .0	.0 .0	19.8 (43.6)	.21 (7.30)	1	10	.0 (.0)
8	3.000 .333						0. (0.)	0. (0.)	.0 .0	.0 .0	20.2 (44.6)	.48 (17.10)	1	10	.0 (.0)
9	3.000 .333						0. (0.)	0. (0.)	.0 .0	.0 .0	15.5 (34.2)	.03 (1.20)	1	10	.0 (.0)
10	3.000 .333						0. (0.)	0. (0.)	.0 .0	.0 .0	16.0 (35.2)	.31 (10.90)	1	10	.0 (.0)
11	3.000 .333						0. (0.)	0. (0.)	.0 .0	.0 .0	15.0 (33.1)	.05 (1.80)	1	10	.0 (.0)
12	3.000 .333						0. (0.)	0. (0.)	.0 .0	.0 .0	15.5 (34.1)	.33 (11.60)	1	10	.0 (.0)

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TABLE 3-6 (concluded)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1	HOT WATER SPRAY-CENTRIFUGE DRYING
2	HOT WATER SPRAY-FORCED HOT AIR ELECTRIC HEAT DRYING
3	HOT WATER SPRAY-FORCED AIR/DISICCANT/ELECTRICALLY HEATED
4	MANUAL WASH-MANUAL WIPE
5	DISPOSABLE CUPS-REUSABLE METALLIC UTENSILS AND DISHES
6	DISPOSABLE CUPS AND NONMETALLIC DISHES-REUSABLE METALLIC UTENSILS
7	DISPOSABLE CUPS AND NONMETALLIC UTENSILS-REUSABLE METALLIC DISHES
8	DISPOSABLE CUPS AND NONMETALLIC UTENSILS AND DISHES
9	REUSABLE CUPS AND METALLIC UTENSILS AND DISHES
10	REUSABLE CUPS AND METALLIC UTENSILS-DISPOSABLE NONMETALLIC DISHES
11	REUSABLE CUPS AND METALLIC DISHES--DISPOSABLE NONMETALLIC UTENSILS
12	REUSABLE CUPS-DISPOSABLE NONMETALLIC UTENSILS AND DISHES

(*)

1 -	CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 -	CABIN AIR	(LOST),	KG/HR	(LB/HR)
3 -	OXYGEN	(LOST),	KG/HR	(LB/HR)
4 -	COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 -	WATER	(LOST),	KG/HR	(LB/HR)
6 -	NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 -	NITROGEN	(USED),	KG/HR	(LB/HR)
8 -	FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 -	WATER	(PROCESSED),	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-7

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 2.1.1 •••• FECES COLLECTION/TRANSFER (SHUTTLE)

CONCEPT NO.	USAGE TIME USES/DAY HRS/USE	CONSUMABLES AND FLOW REQUIREMENTS TYPE (•)	AMT. USED -KG/USE- (LB/USE)	FLOW • (•)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	THERMAL REQMTS COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	ELEC PWR REQMTS PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WT/VOL REQMTS WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	DEVELOPMENT COST AVAIL (••)	INDEX (•••)	RESUPPLY WEIGHT -KG- (LBS)
1	4.000 .150	1	.0000 (.0000)	9.44 (20.00)	.0 (.0)	21.1 (70.0)	0. (0.)	200. (683.)	675.0 62.0	440.0 52.0	107.3 (236.5)	.85 (30.00)	2	25	.0 (.0)
		6	.0000 (.0000)	.00 (.00)	.0 (.0)	21.1 (70.0)									
2	4.000 .225	1	.0000 (.0000)	9.44 (20.00)	.0 (.0)	21.1 (70.0)	0. (0.)	474. (1619.)	680.0 420.0	440.0 360.0	356.8 (786.6)	1.59 (56.00)	2	30	.0 (.0)
		5	1.4769 (3.3000)	88.91 (196.00)	1034.3 (20.0)	32.2 (90.0)									
		6	.0000 (.0000)	.00 (.00)	1551.4 (30.0)	21.1 (70.0)									
3	4.000 .158	1	.0000 (.0000)	9.44 (20.00)	.0 (.0)	21.1 (70.0)	0. (0.)	188. (642.)	400.0 46.0	280.0 36.0	148.3 (376.9)	2.02 (71.50)	2	45	.0 (.0)
4	4.000 6.000	1	.0000 (.0000)	9.44 (20.00)	.0 (.0)	21.1 (70.0)	0. (0.)	1499. (5120.)	500.0 1110.0	360.0 1100.0	163.5 (340.5)	3.61 (127.50)	3	60	.0 (.0)
5	4.000 6.000	3	.1941 (.4280)	.00 (.00)	.0 (.0)	21.1 (70.0)	0. (0.)	1196. (4085.)	500.0 650.0	360.0 640.0	187.6 (413.6)	3.50 (123.50)	3	65	.0 (.0)
6	4.000 6.000	3	.0572 (.1260)	.00 (.00)	.0 (.0)	21.1 (70.0)	0. (0.)	1498. (5115.)	500.0 1150.0	360.0 1140.0	176.4 (388.8)	2.59 (91.50)	3	70	.0 (.0)
7	4.000 3.000	3	.0767 (.1690)	.00 (.00)	62058.0 (1200.0)	21.1 (70.0)	0. (0.)	1050. (3586.)	600.0 640.0	380.0 630.0	486.8 (1073.3)	4.21 (148.50)	3	75	.0 (.0)
8	4.000 .188	1	.0000 (.0000)	3.78 (8.00)	.0 (.0)	21.1 (70.0)	0. (0.)	808. (2760.)	600.0 255.0	380.0 245.0	46.7 (102.9)	.50 (17.80)	1	10	.0 (.0)
9	4.000 1.500						0. (0.)	0. (0.)	.0 .0	.0 .0	9.1 (20.0)	.04 (1.40)	1	0	.0 (.0)

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TABLE 3-7 (concluded)

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	-	DRY JOHN
2	-	DRY JOHN-ANAL WASH
3	-	GERMICIDE
4	-	INTEGRATED VACUUM DECOMPOSITION
5	-	FLUSH FLOW OXYGEN INCINERATION
6	-	PYROLYSIS/BATCH INCINERATION
7	-	WET OXIDIZATION
8	-	SEMIAUTOMATIC BAG SYSTEM (SKYLAB)
9	-	DRY BAGS (APOLLO)

(*)
1 - CABIN AIR (CIRCULATED), LITERS/SEC (FT^3/MIN)
2 - CABIN AIR (LOST), KG/HR (LB/HR)
3 - OXYGEN (LOST), KG/HR (LB/HR)
4 - COOLING WATER (CIRCULATED), KG/HR (LB/HR)
5 - WATER (LOST), KG/HR (LB/HR)
6 - NITROGEN (CIRCULATED), KG/HR (LB/HR)
7 - NITROGEN (USED), KG/HR (LB/HR)
8 - FREON (CIRCULATED), KG/HR (LB/HR)
9 - WATER (PROCESSED), KG/HR (LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-8

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 2.1.2 •••• URINE COLLECTION/TRANSFER (SHUTTLE)

CONCEPT NO.	USAGE TIME USES/DAY HRS/USE	CONSUMABLES AND FLOW REQUIREMENTS TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	THERMAL REQMTS COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	ELEC PWR REQMTS PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WT/VOL REQMTS WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	DEVELOPMENT COST AVAIL (**)	INDEX (***)	RESUPPLY WEIGHT -KG- (LBS)
1	28.000 .018	1	.0000 (.0000)	9.44 (20.00)	.0 (.0)	21.1 (70.0)	0. (0.)	248. (846.)	226.0 18.0	114.0 18.0	263.6 (581.1)	.25 (8.67)	2	50	.0 (.0)
		9	.3629 (.8000)	87.09 (192.00)	.0 (.0)	32.2 (90.0)									
2	28.000 .018	1	.0000 (.0000)	9.44 (20.00)	.0 (.0)	21.1 (70.0)	0. (0.)	229. (781.)	226.0 18.0	114.0 18.0	128.5 (283.3)	.50 (17.50)	2	25	.0 (.0)
		9	.1497 (.3300)	36.29 (80.00)	.0 (.0)	32.2 (90.0)									
3	28.000 .018	1	.0000 (.0000)	9.44 (20.00)	.0 (.0)	21.1 (70.0)	0. (0.)	229. (781.)	226.0 18.0	114.0 18.0	112.5 (248.0)	.05 (1.79)	1	10	.0 (.0)
		9	.1497 (.3300)	36.29 (80.00)	.0 (.0)	32.2 (90.0)									
4	28.000 .018	1	.0000 (.0000)	9.44 (20.00)	.0 (.0)	21.1 (70.0)	0. (0.)	229. (781.)	215.0 10.0	110.0 10.0	108.2 (238.6)	.09 (3.15)	2	35	.0 (.0)
		9	.1497 (.3300)	36.29 (80.00)	.0 (.0)	32.2 (90.0)									
5	28.000 .029	2	.4296 (.9470)	.35 (.77)	.0 (.0)	21.1 (70.0)	0. (0.)	0. (0.)	.0 .0	.0 .0	251.6 (554.7)	.09 (3.17)	1	10	.0 (.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	STANDUP URINAL
2 -	COMMODE URINAL
3 -	INTIMATE MALE ADAPTER (SKYLAB)
4 -	APERTURE URINAL
5 -	LIQUID/GAS FLOW CUFF TYPE (APOLLO)

(*)

1 -	CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 -	CABIN AIR	(LOST) ,	KG/HR	(LB/HR)
3 -	OXYGEN	(LOST) ,	KG/HR	(LB/HR)
4 -	COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 -	WATER	(LOST) ,	KG/HR	(LB/HR)
6 -	NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 -	NITROGEN	(USED) ,	KG/HR	(LB/HR)
8 -	FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 -	WATER	(PROCESSED) ,	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-9

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 2.1.3 •••• VOMITUS COLLECTION/TRANSFER (SHUTTLE)

CONCEPT NO.	USAGE TIME USES/DAY HRS/USE	CONSUMABLES AND FLOW REQUIREMENTS TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	THERMAL REQMTS COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	ELEC PWR REQMTS PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WT/VOL REQMTS WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	DEVELOPMENT COST AVAIL (**)	INDEX (***)	RESUPPLY WEIGHT -KG- (LBS)
1	.560	1	.0000	9.44	.0	21.1	0.	0.	.0	.0	.6	.01	2	25	.0
	.016		(.0000)	(20.00)	(.0)	(70.0)	(0.)	(0.)	.0	.0	(1.3)	(.40)			(.0)
2	.560	1	.0000	9.44	.0	21.1	0.	0.	.0	.0	.7	.01	2	25	.0
	.016		(.0000)	(20.00)	(.0)	(70.0)	(0.)	(0.)	.0	.0	(1.6)	(.33)			(.0)
3	.560						0.	0.	.0	.0	.5	.00	1	0	.0
	.016						(0.)	(0.)	.0	.0	(1.2)	(.01)			(.0)
4	.560	1	.0000	9.44	.0	21.1	0.	249.	250.0	180.0	10.0	.03	2	30	.0
	.016		(.0000)	(20.00)	(.0)	(70.0)	(0.)	(852.)	.0	.0	(22.0)	(.92)			(.0)
		5	.2268	24.95	1551.4	21.1									
			(.5000)	(55.00)	(30.0)	(70.0)									

APPLIANCE CONCEPT NO.	CONCEPT NAME
1	INTIMATE PERSONAL ADAPTOR,DISPOSABLE (MATES WITH COMMODE)
2	INTIMATE PERSONAL ADAPTOR,DISPOSABLE (MATES WITH COMMODE)
3	PORTABLE DISPOSABLE COLLECTOR (TYPE USE COMMERCIALLY)
4	REUSABLE PORTABLE COLLECTOR

(*)

1	CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2	CABIN AIR	(LOST)	KG/HR	(LB/HR)
3	OXYGEN	(LOST)	KG/HR	(LB/HR)
4	COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5	WATER	(LOST)	KG/HR	(LB/HR)
6	NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7	NITROGEN	(USED)	KG/HR	(LB/HR)
8	FREON	(CIRCULATED),	KG/HR	(LB/HR)
9	WATER	(PROCESSED)	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

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TABLE 3-10

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 2.2.1 •••• WHOLE BODY SHOWER (SHUTTLE)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	4.000 .250	1	.0000 (.0000)	21.24 (45.00)	.0 (.0)	21.1 (70.0)	317. (1084.)	292. (997.)	250.0 16.0	250.0 16.0	433.0 (954.6)	2.41 (85.03)	1	25	.0 (.0)
		9	2.2680 (5.0000)	.00 (.00)	1551.4 (30.0)	40.6 (105.0)									
2	4.000 .250	1	.0000 (.0000)	221.81 (470.00)	.0 (.0)	21.1 (70.0)	4665. (15931.)	79. (271.)	5370.0 16.0	5370.0 16.0	359.3 (792.0)	2.20 (77.57)	2	40	.0 (.0)
		9	2.2680 (5.0000)	.00 (.00)	1551.4 (30.0)	40.6 (105.0)									
3	4.000 .250	9	2.2680 (5.0000)	.00 (.00)	1551.4 (30.0)	40.6 (105.0)	124. (424.)	989. (3378.)	337.0 .0	.0 .0	761.6 (1679.0)	2.69 (95.08)	1	15	.0 (.0)
4	4.000 .250	9	2.7216 (6.0000)	.00 (.00)	1292.9 (25.0)	41.1 (106.0)	77. (264.)	292. (997.)	99.0 .0	86.0 .0	394.0 (868.6)	1.73 (61.11)	1	5	.0 (.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1	VACUUM PICKUP
2	AIR DRAG
3	MECHANICAL
4	COLLAPSIBLE

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(*)

1 -	CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 -	CABIN AIR	(LOST) ,	KG/HR	(LB/HR)
3 -	OXYGEN	(LOST) ,	KG/HR	(LB/HR)
4 -	COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 -	WATER	(LOST) ,	KG/HR	(LB/HR)
6 -	NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 -	NITROGEN	(USED) ,	KG/HR	(LB/HR)
8 -	FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 -	WATER	(PROCESSED) ,	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-11

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 2.2.2 **** PARTIAL BODY WASHING (SHUTTLE)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	40.000	2	.0003	.00	.0	21.1	105.	278.	500.0	240.0	233.6	.60	2	30	.0
	.037		(.0007)	(.00)	(.0)	(70.0)	(360.)	(948.)	.0	.0	(515.0)	(21.20)			(.0)
		9	.2268	.00	1551.4	.0									
			(.5000)	(.00)	(30.0)	(.0)									
2	40.000	5	.0109	.00	1.0	.0	105.	278.	501.1	240.0	208.1	.10	2	30	.0
	.037		(.0240)	(.00)	(.0)	(.0)	(360.)	(948.)	.0	.0	(458.8)	(3.60)			(.0)
		9	.2268	.01	1551.4	.0									
			(.5000)	(.02)	(30.0)	(.0)									
3	40.000						0.	0.	.0	.0	43.5	.06	1	10	.0
	.037						(0.)	(0.)	.0	.0	(96.0)	(2.20)			(.0)
4	40.000	9	.0227	.00	1551.4	.0	422.	11.	52.8	32.0	28.0	.04	2	50	.0
	.037		(.0500)	(.00)	(30.0)	(.0)	(1440.)	(37.)	.0	.0	(61.7)	(1.51)			(.0)
5	40.000	9	.2268	.00	1551.4	.0	105.	278.	500.0	240.0	546.9	.20	2	30	.0
	.037		(.5000)	(.00)	(30.0)	(.0)	(360.)	(948.)	.0	.0	(1205.6)	(7.20)			(.0)
6	40.000	9	.2268	.00	1810.0	51.7	32.	30.	57.5	.0	213.9	.29	1	5	.0
	.037		(.5000)	(.00)	(35.0)	(125.0)	(110.)	(101.)	140.0	.0	(471.6)	(10.10)			(.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1	DISPOSABLE WET WIPES
2	REUSABLE WET WIPES
3	DISPOSABLE WIPES (PREPACKAGED)
4	AUTOMATIC SPONGE
5	REUSABLE WASHCLOTHES
6	DISPOSABLE WASHCLOTHES (SKYLAB)

(*)

1 - CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 - CABIN AIR	(LOST)	, KG/HR	(LB/HR)
3 - OXYGEN	(LOST)	, KG/HR	(LB/HR)
4 - COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 - WATER	(LOST)	, KG/HR	(LB/HR)
6 - NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 - NITROGEN	(USED)	, KG/HR	(LB/HR)
8 - FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 - WATER	(PROCESSED)	, KG/HR	(LB/HR)

(**)AVAILABLE

(1) AVAILABLE

(2) STATE OF THE ART

(3) SOME DEVELOPMENT REQUIRED

(4) EXTENSIVE DEV. REQUIRED

(***)COST INDICATOR

0-25%

25-50%

50-75%

75-100%

TABLE 3-12

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 2.2.3 .... PARTIAL BODY DRYING (SHUTTLE)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	90.000 .056	5	3.1298 (6.9000)	.00 (.00)	.0 (.0)	.0 (.0)	25. (85.)	198. (675.)	67.2 .0	.0 .0	2582.8 (5693.9)	.14 (5.12)	1	5	.0 (.0)
2	90.000 .056	5	.0111 (.0245)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	0. (0.)	.0 .0	.0 .0	19.6 (43.3)	.17 (5.89)	1	5	.0 (.0)
3	90.000 .016	1	.0000 (.0000)	70.79 (150.00)	.0 (.0)	21.1 (70.0)	0. (0.)	76. (261.)	1725.0 .0	.0 .0	7.3 (16.0)	.02 (.53)	1	5	.0 (.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	REUSABLE DRY WIPES
2 -	DISPOSABLE DRY WIPES
3 -	ELECTRIC DRYER

(*)

1 -	CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 -	CABIN AIR	(LOST),	KG/HR	(LB/HR)
3 -	OXYGEN	(LOST),	KG/HR	(LB/HR)
4 -	COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 -	WATER	(LOST),	KG/HR	(LB/HR)
6 -	NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 -	NITROGEN	(USED),	KG/HR	(LB/HR)
8 -	FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 -	WATER	(PROCESSED),	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-13

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 2.3.1 .... SHAVING (SHUTTLE)

CONCEPT NO.	USAGE TIME USES/DAY HRS/USE	CONSUMABLES AND FLOW REQUIREMENTS TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	THERMAL REQMTS COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	ELEC PWR REQMTS PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WT/VOL REQMTS WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	DEVELOPMENT COST AVAIL (**)	INDEX (***)	RESUPPLY WEIGHT -KG- (LBS)
1	4.000 .100						0. (0.)	0. (0.)	.0 .0	.0 .0	1.0 (2.1)	.00 (.06)	0	0	.0 (.0)
2	4.000 .100	1	.0000 (.0000)	4.72 (10.00)	.0 (.0)	21.1 (70.0)	0. (0.)	12. (41.)	30.0 115.0	30.0 .0	2.2 (4.7)	.01 (.42)	0	10	.0 (.0)
3	4.000 .100						0. (0.)	0. (0.)	.0 .0	.0 .0	.5 (1.0)	.00 (.02)	0	0	.0 (.0)
4	4.000 .100	1	.0000 (.0000)	21.71 (46.00)	.0 (.0)	21.1 (70.0)	0. (0.)	0. (0.)	.0 .0	.0 .0	.2 (.4)	.00 (.03)	0	10	.0 (.0)
5	4.000 .100	1	.0000 (.0000)	4.72 (10.00)	.0 (.0)	21.1 (70.0)	0. (0.)	12. (41.)	30.0 115.0	30.0 .0	1.3 (2.8)	.00 (.10)	0	15	.0 (.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1	WET SHAVE WITH SAFETY RAZOR AND CREAM
2	DRY SHAVE-ELECTRIC RAZOR/VACUUM COLLECTION
3	DRY SHAVE-WINDUP RAZOR
4	DRY SHAVE-VACUUM DRIVEN RAZOR
5	WET SHAVE-SAFETY RAZOR/VACUUM

(*)

1 -	CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 -	CABIN AIR	(LOST),	KG/HR	(LB/HR)
3 -	OXYGEN	(LOST),	KG/HR	(LB/HR)
4 -	COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 -	WATER	(LOST),	KG/HR	(LB/HR)
6 -	NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 -	NITROGEN	(USED),	KG/HR	(LB/HR)
8 -	FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 -	WATER	(PROCESSED),	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

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TABLE 3-14

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 2.3.2 .... HAIR CUTTING (SHUTTLE)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	.070 .097						0. (0.)	33. (114.)	50.0 115.0	.0 .0	.9 (2.0)	.01 (.25)	0	10	.0 (.0)
2	.140 .203						0. (0.)	3. (11.)	.0 115.0	.0 .0	.7 (1.5)	.01 (.25)	0	10	.0 (.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1	POWER CLIPPER/VACUUM COLLECTION
2	RAZOR COMB/VACUUM COLLECTION

(*)

1 -	CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 -	CABIN AIR	(LOST) ,	KG/HR	(LB/HR)
3 -	OXYGEN	(LOST) ,	KG/HR	(LB/HR)
4 -	COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 -	WATER	(LOST) ,	KG/HR	(LB/HR)
6 -	NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 -	NITROGEN	(USED) ,	KG/HR	(LB/HR)
8 -	FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 -	WATER	(PROCESSED) ,	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

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TABLE 3-15

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 2.3.4 .... TEETH BRUSHING (SHUTTLE)

CONCEPT NO.	USAGE TIME USES/DAY HRS/USE	CONSUMABLES AND FLOW REQUIREMENTS TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	THERMAL REQMTS COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	ELEC PWR REQMTS PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WT/VOL REQMTS WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	DEVELOPMENT COST AVAIL (**)	INDEX (***)	RESUPPLY WEIGHT -KG- (LBS)
1	16.000 .082						0. (0.)	0. (0.)	.0 .0	.0 .0	6.4 (14.0)	.03 (1.20)	1	0	.0 (.0)
2	16.000 .082	5	.0567 (.1250)	.68 (1.50)	1551.4 (30.0)	21.1 (70.0)	0. (0.)	8. (27.)	24.0 .0	.0 .0	1.2 (2.7)	.00 (.09)	1	20	.0 (.0)
3	16.000 .082						0. (0.)	2. (7.)	6.0 .0	.0 .0	5.9 (13.0)	.01 (.37)	1	10	.0 (.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	TOOTHPASTE WITH DENTIFRICE
2 -	WATER PIK
3 -	ELECTRIC TOOTHBRUSH

(*)

1 - CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 - CABIN AIR	(LOST) ,	KG/HR	(LB/HR)
3 - OXYGEN	(LOST) ,	KG/HR	(LB/HR)
4 - COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 - WATER	(LOST) ,	KG/HR	(LB/HR)
6 - NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 - NITROGEN	(USED) ,	KG/HR	(LB/HR)
8 - FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 - WATER	(PROCESSED) ,	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

OK

TABLE 3-16

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 3.1.1 **** SURFACE WIPING (SHUTTLE)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	15.000 .037	2	.0003 (.0007)	.00 (.00)	.0 (.0)	21.1 (70.0)	105. (360.)	278. (948.)	500.0 .0	360.0 .0	112.5 (248.0)	.68 (23.93)	2	30	.0 (.0)
		5	.2268 (.5000)	.00 (.00)	1551.4 (30.0)	21.1 (70.0)									
2	15.000 .037	2	.0003 (.0007)	.00 (.00)	.0 (.0)	.0 (.0)	105. (360.)	278. (948.)	500.0 .0	360.0 .0	103.0 (227.0)	.20 (7.10)	2	30	.0 (.0)
		5	.2631 (.5800)	.00 (.00)	1551.4 (30.0)	21.1 (70.0)									
3	15.000 .037						0. (0.)	0. (0.)	.0 .0	.0 .0	39.1 (86.3)	.08 (2.80)	1	10	.0 (.0)
4	15.000 .037	5	.2268 (.5000)	.00 (.00)	1551.4 (30.0)	21.1 (70.0)	633. (2160.)	11. (37.)	52.8 .0	31.5 .0	78.9 (173.8)	.11 (3.96)	2	50	.0 (.0)
5	15.000 .037	2	.0003 (.0007)	.00 (.00)	.0 (.0)	.0 (.0)	105. (360.)	278. (948.)	500.0 .0	361.0 .0	113.6 (250.5)	.25 (8.77)	2	30	.0 (.0)
		5	.2835 (.6250)	.00 (.00)	1551.4 (30.0)	21.1 (70.0)									
6	15.000 .037	2	.0003 (.0007)	.00 (.00)	.0 (.0)	.0 (.0)	32. (110.)	30. (101.)	57.5 140.0	57.5 140.0	100.1 (220.7)	.22 (7.83)	1	5	.0 (.0)
		5	.2381 (.5250)	.00 (.00)	1810.0 (35.0)	51.7 (125.0)									
7	15.000 .037	2	.0003 (.0007)	.00 (.00)	.0 (.0)	21.1 (70.0)	105. (360.)	278. (948.)	500.0 .0	360.0 .0	826.7 (1822.5)	1.46 (51.72)	2	30	.0 (.0)
		5	2.5402 (5.6000)	.00 (.00)	1551.4 (30.0)	51.7 (125.0)									
8	15.000 .037	5	2.5764 (5.6800)	.00 (.00)	1551.4 (30.0)	51.7 (125.0)	105. (360.)	278. (948.)	500.0 .0	360.0 .0	817.3 (1801.7)	.99 (34.89)	2	30	.0 (.0)
9	15.000 .037	5	2.5991 (5.7300)	.00 (.00)	1551.4 (30.0)	51.7 (125.0)	105. (360.)	278. (948.)	500.0 .0	360.0 .0	828.4 (1826.3)	1.03 (36.54)	2	30	.0 (.0)
10	15.000 .037	5	2.5402 (5.6000)	.00 (.00)	1810.0 (35.0)	51.7 (125.0)	32. (110.)	30. (101.)	57.5 140.0	57.5 140.0	814.1 (1794.7)	1.01 (35.52)	1	5	.0 (.0)

TABLE 3-16 (concluded)

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 11   15.000   5    .2268     .00  1551.4    51.7     105.     278.    500.0   360.0    85.7      .17  2  30      .0
          .037    (  .5000)(  .00)  (30.0) (125.0)  (  360.)  (  948.)     .0      .0  ( 188.9) (  6.10)       (  .0)
 12   15.000   5    .2268     .00  1551.4    51.7      32.      30.     57.5    57.5    87.5      .11  1   5      .0
          .037    (  .5000)(  .00)  (30.0) (125.0)  (  110.)  (  101.)   140.0   140.0  ( 192.8) (  3.80)       (  .0)
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APPLIANCE
 CONCEPT
   NO.        C O N C E P T   N A M E

     1  -   DISPOSABLE WET/DRY WIPES
     2  -   REUSABLE WET WIPES-DISPOSABLE DRY WIPES
     3  -   DISPOSABLE WET/DRY WIPES (PREPACKAGED)
     4  -   AUTOMATIC SPONGE MOP
     5  -   REUSABLE CLEANING CLOTHS DISPOSABLE DRY WIPES
     6  -   DISPOSABLE CLEANING CLOTHS (SKLAB) DISPOSABLE DRY WIPES
     7  -   DISPOSABLE WET WIPES REUSABLE DRY WIPES
     8  -   REUSABBLE WET/DRY WIPES
     9  -   REUSABLE CLEANING CLOTHS/DRY WIPES
    10  -   DISPOSABLE CLEANING CLOTHS REUSABLE DRY WIOES
    11  -   SPONGES/ENCLOSED WETTING UNIT
    12  -   SPONGES/SKYLAB TYPE WETTING UNIT
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(*)
1 - CABIN AIR (CIRCULATED), LITERS/SEC (FT^3/MIN)
2 - CABIN AIR (LOST), KG/HR (LB/HR)
3 - OXYGEN (LOST), KG/HR (LB/HR)
4 - COOLING WATER (CIRCULATED), KG/HR (LB/HR)
5 - WATER (LOST), KG/HR (LB/HR)
6 - NITROGEN (CIRCULATED), KG/HR (LB/HR)
7 - NITROGEN (USED), KG/HR (LB/HR)
8 - FREON (CIRCULATED), KG/HR (LB/HR)
9 - WATER (PROCESSED), KG/HR (LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-17

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 3.2.1 •••• MANUAL REFUSE COLLECTION (SHUTTLE)

CONCEPT NO.	USAGE TIME USES/DAY HRS/USE	CONSUMABLES AND FLOW REQUIREMENTS TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	THERMAL REQMTS COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	ELEC PWR REQMTS PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WT/VOL REQMTS WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	DEVELOPMENT COST AVAIL (**)	INDEX (***)	RESUPPLY WEIGHT -KG- (LBS)
1	.000						0.	0.	.0	.0	6.6	.09	1	0	.0
	.000						(0.)	(0.)	.0	.0	(14.6)	(3.05)			(.0)
2	.000						0.	0.	.0	.0	10.3	.19	1	0	.0
	.000						(0.)	(0.)	.0	.0	(22.8)	(6.83)			(.0)
3	.000						0.	0.	.0	.0	7.3	.07	1	0	.0
	.000						(0.)	(0.)	.0	.0	(16.1)	(2.39)			(.0)

APPLIANCE CONCEPT NO. — CONCEPT NAME

1 - DISPOSABLE TRASH BAG
2 - REUSABLE WASTE RECEPTICLES
3 - DISPOSABLE WASTE RECEPTICLES

(*)
1 - CABIN AIR (CIRCULATED), LITERS/SEC (FT^3/MIN)
2 - CABIN AIR (LOST) , KG/HR (LB/HR)
3 - OXYGEN (LOST) , KG/HR (LB/HR)
4 - COOLING WATER (CIRCULATED), KG/HR (LB/HR)
5 - WATER (LOST) , KG/HR (LB/HR)
6 - NITROGEN (CIRCULATED), KG/HR (LB/HR)
7 - NITROGEN (USED) , KG/HR (LB/HR)
8 - FREON (CIRCULATED), KG/HR (LB/HR)
9 - WATER (PROCESSED) , KG/HR (LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-18

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 3.2.2 .... VACUUM REFUSE COLLECTION (SHUTTLE)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS.	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	5.000 .082						0. (0.)	77. (262.)	.0 115.0	.0 .0	13.8 (30.4)	.02 (.79)	1	5	.0 (.0)
2	5.000 .082						0. (0.)	160. (546.)	240.0 .0	.0 .0	4.6 (10.0)	.01 (.30)	1	20	.0 (.0)
3	5.000 .082	3	.6214 (1.3700)	4.54 (10.00)	.0 (.0)	21.1 (70.0)	0. (0.)	0. (0.)	.0 .0	.0 .0	66.9 (147.5)	.01 (.19)	1	25	.0 (.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1	VACUUM CLEANER (SKYLAB)
2	VACUUM CLEANER (COMMERICAL)
3	VACUUM CLEANER-VENTED TO SPACE

(*)

1 - CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 - CABIN AIR	(LOST)	, KG/HR	(LB/HR)
3 - OXYGEN	(LOST)	, KG/HR	(LB/HR)
4 - COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 - WATER	(LOST)	, KG/HR	(LB/HR)
6 - NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 - NITROGEN	(USED)	, KG/HR	(LB/HR)
8 - FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 - WATER	(PROCESSED)	, KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

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TABLE 3-19

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 3.2.4 •••• REFUSE PROCESSING (SHUTTLE)

CONCEPT NO.	USAGE TIME USES/DAY HRS/USE	CONSUMABLES AND FLOW REQUIREMENTS TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	THERMAL REQMTS COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	ELEC PWR REQMTS PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WT/VOL REQMTS WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	DEVELOPMENT COST AVAIL (**)	INDEX (***)	RESUPPLY WEIGHT -KG- (LBS)
1	2.010	1	.0000	.00	1810.0	21.1	0.	0.	.0	.0	35.0	.08	2	30	.0
	.017		(.0000)	(.00)	(35.0)	(70.0)	(0.)	(0.)	10.0	.0	(77.2)	(3.00)			(.0)
2	2.010	2	.0163	.00	.0	.0	0.	0.	.0	.0	36.4	.09	2	30	.0
	.017		(.0360)	(.00)	(.0)	(.0)	(0.)	(0.)	10.0	.0	(80.3)	(3.20)			(.0)
3	2.010						0.	50.	745.0	745.0	37.3	.08	2	30	.0
	.017						(0.)	(169.)	.0	.0	(82.2)	(3.00)			(.0)
4	9.180						0.	0.	.0	.0	12.9	.41	2	50	.0
	.017						(0.)	(0.)	.0	.0	(28.5)	(14.40)			(.0)
5	2.010	1	.0000	.00	1810.0	21.1	0.	149.	745.0	745.0	69.1	.13	2	40	.0
	.017		(.0000)	(.00)	(35.0)	(70.0)	(0.)	(509.)	10.0	10.0	(152.2)	(4.60)			(.0)
6	2.010	2	.0163	.00	.0	.0	0.	149.	745.0	745.0	69.7	.13	2	40	.0
	.017		(.0360)	(.00)	(.0)	(.0)	(0.)	(509.)	10.0	10.0	(153.7)	(4.60)			(.0)
7	2.010						0.	199.	745.0	745.0	71.3	.13	2	40	.0
	.017						(0.)	(678.)	.0	.0	(157.2)	(4.60)			(.0)
8	9.180						0.	149.	745.0	745.0	46.9	.45	2	40	.0
	.017						(0.)	(509.)	.0	.0	(103.4)	(16.00)			(.0)
9	2.000	1	.0000	9.44	.0	.0	0.	1394.	1400.0	.0	85.0	1.83	3	60	.0
	12.000		(.0000)	(20.00)	(.0)	(.0)	(0.)	(4760.)	.0	.0	(187.5)	(64.50)			(.0)
10	2.000	3	.5820	.00	.0	21.1	0.	999.	1000.0	.0	113.0	1.77	3	65	.0
	12.000		(1.2830)	(.00)	(.0)	(70.0)	(0.)	(3410.)	.0	.0	(249.1)	(62.60)			(.0)
11	2.000	3	.1706	.00	.0	21.1	0.	1394.	1400.0	.0	96.1	1.31	3	70	.0
	12.000		(.3760)	(.00)	(.0)	(70.0)	(0.)	(4760.)	.0	.0	(211.9)	(46.30)			(.0)
12	2.000	3	.2291	.00	62058.0	21.1	0.	899.	900.0	.0	253.0	2.13	3	75	.0
	12.000		(.5050)	(.00)	1200.0)	(70.0)	(0.)	(3070.)	.0	.0	(557.7)	(75.30)			(.0)

TABLE 3-19 (concluded)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1	COMPACTOR-AIR PRESSURE
2	COMPACTOR-VACUUM
3	COMPACTOR-MOTOR
4	COMPACTOR-MANUAL
5	COMPACTOR-AIR PRESSURE W/SHREDDER
6	COMPACTOR-VACUUM W/SHREDDER
7	COMPACTOR-MOTOR W/SHREDDER
8	COMPACTOR-MANUAL W/SHREDDER
9	INTEGRATED VACUUM DECOMPOSTION/SHREDDER
10	FLUSH FLOW OXYGEN INCINERATION/SHREDDER
11	PYROLYSIS/BATCH INCINERATION/SHREDDER
12	WET OXIDIZATION/ SHREDDER

(*)
1 - CABIN AIR (CIRCULATED), LITERS/SEC (FT^3/MIN)
2 - CABIN AIR (LOST), KG/HR (LB/HR)
3 - OXYGEN (LOST), KG/HR (LB/HR)
4 - COOLING WATER (CIRCULATED), KG/HR (LB/HR)
5 - WATER (LOST), KG/HR (LB/HR)
6 - NITROGEN (CIRCULATED), KG/HR (LB/HR)
7 - NITROGEN (USED), KG/HR (LB/HR)
8 - FREON (CIRCULATED), KG/HR (LB/HR)
9 - WATER (PROCESSED), KG/HR (LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-20

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 3.2.5 .... REFUSE DISPOSAL (SHUTTLE)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	.783 .641	2	.1456 (.3210)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	0. (0.)	.0 .0	.0 .0	79.1 (174.4)	.23 (8.20)	1	10	.0 (.0)
2	.787 .691						0. (0.)	0. (0.)	.0 .0	.0 .0	8.7 (19.2)	.38 (13.28)	1	10	.0 (.0)
3	.098 .328						0. (0.)	0. (0.)	.0 10.0	.0 .0	75.3 (166.1)	.52 (18.41)	2	35	.0 (.0)

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	-	VACUUM STORAGE
2	-	STORAGE BIN/CONTAINER
3	-	SOLID PROPELLANT REFUSE ROCKET

(*)

1 - CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 - CABIN AIR	(LOST)	, KG/HR	(LB/HR)
3 - OXYGEN	(LOST)	, KG/HR	(LB/HR)
4 - COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 - WATER	(LOST)	, KG/HR	(LB/HR)
6 - NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 - NITROGEN	(USED)	, KG/HR	(LB/HR)
8 - FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 - WATER	(PROCESSED)	, KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-21

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 3.3.1 **** GARMENT/LINEN WASHING (SHUTTLE)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	2.000 1.000	9	33.2942 (73.4000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	972. (3320.)	150.0 .0	.0 .0	776.2 (1711.1)	.33 (11.60)	3	70	.0 (.0)
2	2.000 1.000	9	33.2942 (73.4000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	980. (3347.)	158.0 .0	.0 .0	774.3 (1707.1)	.35 (12.30)	3	60	.0 (.0)
3	2.000 1.000	9	33.2942 (73.4000)	.00 (.00)	.0 (.0)	.0 (.0)	395. (1350.)	923. (3152.)	144.0 154.0	.0 .0	843.7 (1860.1)	1.34 (47.40)	4	90	.0 (.0)
4	2.000 1.000	9	33.2942 (73.4000)	.00 (.00)	.0 (.0)	.0 (.0)	395. (1350.)	902. (3079.)	144.0 454.0	.0 .0	846.5 (1866.1)	1.34 (47.40)	4	90	.0 (.0)
5	2.000 1.000	7	.0907 (.2000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	872. (2979.)	50.0 .0	.0 .0	766.3 (1689.3)	.28 (10.00)	4	95	.0 (.0)
		9	33.2942 (73.4000)	.00 (.00)	.0 (.0)	.0 (.0)									
6	2.000 1.000	7	.1361 (.3000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	872. (2979.)	50.0 .0	.0 .0	763.5 (1683.1)	.27 (9.70)	4	95	.0 (.0)
		9	33.2942 (73.4000)	.00 (.00)	.0 (.0)	.0 (.0)									
7	2.000 1.000	9	33.2942 (73.4000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	980. (3347.)	158.0 .0	.0 .0	776.2 (1711.1)	.34 (11.90)	2	40	.0 (.0)
8	2.000 1.000	9	33.2942 (73.4000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	1847. (6307.)	1023.0 .0	.0 .0	780.7 (1721.1)	.37 (12.90)	3	60	.0 (.0)
9	2.000 1.000	9	6.0782 (13.4000)	.00 (.00)	.0 (.0)	.0 (.0)	264. (900.)	170. (579.)	96.0 303.0	.0 .0	194.6 (429.1)	.80 (28.30)	3	50	.0 (.0)
10	2.000 1.000	9	33.2942 (73.4000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	980. (3347.)	158.0 .0	.0 .0	776.2 (1711.1)	.34 (11.90)	3	50	.0 (.0)

ok

TABLE 3-21 (concluded)

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	-	MECHANICAL OSCILLATION
2	-	FLUIDIC AGITATION
3	-	PISTON AGITATION
4	-	CYCLIC VALVE AND PUMP AGITATION
5	-	DIAPHRAM ACTUATED-ONE DIRECTIONAL SQUEEZE
6	-	DIAPHRAM ACTUATED-TWO DIRECTIONAL SQUEEZE
7	-	WATER SPRAY AGITATED
8	-	ULTRASONIC
9	-	MANUAL WASHBOARD
10	-	PLAIN RECIRCULATION

(*)

1 -	CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 -	CABIN AIR	(LOST),	KG/HR	(LB/HR)
3 -	OXYGEN	(LOST),	KG/HR	(LB/HR)
4 -	COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 -	WATER	(LOST),	KG/HR	(LB/HR)
6 -	NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 -	NITROGEN	(USED),	KG/HR	(LB/HR)
8 -	FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 -	WATER	(PROCESSED),	KG/HR	(LB/HR).

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-22

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 3.3.2 .... GARMENT/LINEN DRYING (SHUTTLE)

CONCEPT NO.	USAGE TIME USES/DAY HRS/USE	CONSUMABLES AND FLOW REQUIREMENTS TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	THERM. REQMTS COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	ELEC PWR REQMTS PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WT/VOL REQMTS WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	DEVELOPMENT COST AVAIL (**)	INDEX (***)	RESUPPLY WEIGHT -KG- (LBS)
1	2.000						132.	71.	48.0	.0	24.0	.33	2	30	.0
	4.000						(450.)	(242.)	151.0	.0	(53.0)	(11.70)			(.0)
2	2.000						219.	100.	62.0	.0	54.4	.43	3	65	.0
	4.000						(747.)	(343.)	.0	.0	(120.0)	(15.10)			(.0)
3	2.000	2	.0014	.00	.0	.0	0.	64.	91.3	.0	35.2	.39	3	60	.0
	4.000		(.0031)	(.00)	(.0)	(.0)	(0.)	(217.)	.0	.0	(77.6)	(13.60)			(.0)
		5	.2404	.00	.0	.0									
			(.5300)	(.00)	(.0)	(.0)									
4	2.000						59.	64.	91.3	.0	23.1	.34	3	60	.0
	4.000						(200.)	(217.)	67.3	.0	(51.0)	(11.90)			(.0)
5	2.000	2	.0231	.00	.0	.0	0.	0.	36.7	.0	26.8	.15	2	30	.0
	3.175		(.0510)	(.00)	(.0)	(.0)	(0.)	(0.)	.0	.0	(59.0)	(5.40)			(.0)
		5	.2404	.00	.0	.0									
			(.5300)	(.00)	(.0)	(.0)									
6	2.000	2	.0231	.00	.0	.0	0.	9.	36.7	.0	31.3	.17	2	35	.0
	4.000		(.0510)	(.00)	(.0)	(.0)	(0.)	(30.)	60.0	.0	(69.0)	(6.00)			(.0)
		5	.2404	.00	.0	.0									
			(.5300)	(.00)	(.0)	(.0)									
7	2.000	2	.0231	.00	.0	.0	0.	9.	36.7	.0	35.8	.20	3	70	.0
	4.000		(.0510)	(.00)	(.0)	(.0)	(0.)	(30.)	.0	.0	(79.0)	(7.00)			(.0)
		5	.2404	.00	.0	.0									
			(.5300)	(.00)	(.0)	(.0)									
8	2.000						0.	31.	4.7	.0	15.1	2.48	1	5	.0
	8.000						(0.)	(105.)	.0	.0	(33.3)	(87.70)			(.0)
9	2.000						0.	172.	2.0	.0	12.1	2.64	1	10	.0
	4.000						(0.)	(589.)	171.0	.0	(26.7)	(93.30)			(.0)

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TABLE 3-22 (concluded)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	FORCED HOT AIR-ELECTRIC
2 -	FORCED HOT AIR-HEAT FROM THERMAL STORAGE UNIT
3 -	FORCED COLD DRY AIR-DISICCANT(VACUUM REGENERABLE)
4 -	FORCED COLD DRY AIR-DISICCANT(ELECTRIC HEAT REGENERABLE)
5 -	VACUUM DRY
6 -	THERMAL VACUUM DRY-ELECTRIC HEAT
7 -	THERMAL VACUUM DRY-THERMAL STORAGE/RADIANT HEAT
8 -	CLOTHES LINE-FORCED CONVECTION
9 -	CLOTHES LINE-FORCED CONVECTION-ELECTRIC HEAT

(*)
1 - CABIN AIR (CIRCULATED), LITERS/SEC (FT^3/MIN)
2 - CABIN AIR (LOST) , KG/HR (LB/HR)
3 - OXYGEN (LOST) , KG/HR (LB/HR)
4 - COOLING WATER (CIRCULATED), KG/HR (LB/HR)
5 - WATER (LOST) , KG/HR (LB/HR)
6 - NITROGEN (CIRCULATED), KG/HR (LB/HR)
7 - NITROGEN (USED) , KG/HR (LB/HR)
8 - FREON (CIRCULATED), KG/HR (LB/HR)
9 - WATER (PROCESSED) , KG/HR (LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-23

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 3.3.3. **** GARMENT/LINEN WASHER/DRYER-DISPOSABLE CLOTHES (SHUTTLE)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	2.000 5.000	9	33.2942 (73.4000)	.00 (.00)	.0 (.0)	.0 (.0)	132. (450.)	980. (3347.)	158.0 151.0	.0 .0	111.6 (246.0)	.43 (15.10)	3	60	.0 (.0)
2	2.000 5.000	9	33.2942 (73.4000)	.00 (.00)	.0 (.0)	.0 (.0)	219. (747.)	980. (3347.)	158.0 .0	.0 .0	120.2 (265.0)	1.07 (37.80)	3	65	.0 (.0)
3	2.000 9.000	9	33.2942 (73.4000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	980. (3347.)	158.0 .0	.0 .0	91.2 (201.0)	2.91 (102.70)	3	60	.0 (.0)
4	2.000 5.000	9	33.2942 (73.4000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	980. (3347.)	158.0 171.0	.0 .0	87.5 (193.0)	3.10 (109.40)	3	60	.0 (.0)
5	2.000 5.000	9	33.2942 (73.4000)	.00 (.00)	.0 (.0)	.0 (.0)	132. (450.)	980. (3347.)	158.0 151.0	.0 .0	90.3 (199.0)	.44 (15.40)	2	40	.0 (.0)
6	2.000 5.000	9	33.2942 (73.4000)	.00 (.00)	.0 (.0)	.0 (.0)	219. (747.)	980. (3347.)	158.0 .0	.0 .0	122.0 (269.0)	.67 (23.80)	3	65	.0 (.0)
7	2.000 9.000	9	33.2942 (73.4000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	980. (3347.)	158.0 .0	.0 .0	93.0 (205.0)	2.90 (102.50)	2	40	.0 (.0)
8	2.000 5.000	9	33.2942 (73.4000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	980. (3347.)	158.0 171.0	.0 .0	90.3 (199.0)	3.09 (109.00)	2	40	.0 (.0)
9	.000 .000	9	.0000 (.0000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	0. (0.)	158.0 .0	.0 .0	51.7 (114.0)	.61 (21.50)	1	0	.0 (.0)

TABLE 3-23 (concluded)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	FLUIDIC AGITATION/FORCED HOT AIR-ELECTRIC HEATER
2 -	FLUIDIC AGITATION/FORCED HOT AIR-THERMAL STORAGE HEATER
3 -	FLUIDIC AGITATION/FORCED AIR DRYING-CLOTHES LINE
4 -	FLUIDIC AGITATION/FORCED AIR DRYING-CLOTHES LINE
5 -	WATER SPRAY AGITATION/FORCED HOT AIR-ELECTRIC HEATER
6 -	WATER SPRAY AGITATION/FORCED HOT AIR-THERMAL STORAGE HEATER
7 -	WATER SPRAY AGITATION/FORCRD AIR DRYING-CLOTHES LINE
8 -	WATER SPRAY AGITATION/ELECTRICALLY HEATED-CLOTHES LINE
9 -	DISPOSABLE CLOTHES

(*)

1 - CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 - CABIN AIR	(LOST)	, KG/HR	(LB/HR)
3 - OXYGEN	(LOST)	, KG/HR	(LB/HR)
4 - COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 - WATER	(LOST)	, KG/HR	(LB/HR)
6 - NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 - NITROGEN	(USED)	, KG/HR	(LB/HR)
8 - FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 - WATER	(PROCESSED)	, KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-24

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 4.1.1 •••• MUSIC [SHUTTLE]

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	2.000 2.000						0. (0.)	0. (0.)	.0 .0	.0 .0	29.2 (64.3)	.04 (1.49)	1	5	.0 (.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	CASSETTE PLAYER/RECORDER

TABLE 3-25

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 9.1.2 **** LIBRARY (SHUTTLE)

CONCEPT NO.	USAGE TIME USES/DAY HRS/USE	CONSUMABLES AND FLOW REQUIREMENTS TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	THERMAL REQMTS COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	ELEC PWR REQMTS PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WT/VOL REQMTS WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	DEVELOPMENT COST AVAIL (**)	INDEX (***)	RESUPPLY WEIGHT -KG- (LBS)
1	2.000 2.000						0. (0.)	0. (0.)	.0 .0	.0 .0	.5 (1.0)	.01 (.33)	1	5	.0 (.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 *	BOOKS

TABLE 3-26

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 4.1.3 **** VISUAL RECREATION (SHUTTLE)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	2.000 2.000						0. (0.)	120. (409.)	120.0 .0	.0 .0	22.7 (50.0)	.12 (4.27)	3	75	.0 (.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	TELEVISION

TABLE 3-27

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 9.1.9 •••• GAMES (SHUTTLE)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	.500 2.000						0. (0.)	0. (0.)	.0 .0	.0 .0	.4 (.8)	.00 (.07)	1	5	.0 (.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	HANDBALL

TABLE 3-28

APPLIANCE CONCEPT FUNCTION MATRIX

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INDEX NO. 4.2.1   ....  EXERCISERS (SHUTTLE)

CONCEPT  USAGE      CONSUMABLES AND FLOW REQUIREMENTS       THERMAL REQMTS      ELEC PWR REQMTS   WT/VOL REQMTS   DEVELOPMENT  RESUPPLY
  NO.    TIME                                                                                                      COST
  ---    --------  -----------------------------------    ---------------    ---------------   -------------   -----------  --------
                             AMT.                                            PK PWR   AVG PWR
         USES/DAY  TYPE    USED       FLOW   PRESS   TEMP    COOLANT  HT LEAK     AC       AC     WEIGHT VOLUME  AVAIL INDEX    WEIGHT
         HRS/USE   (*)   -KG/USE-      *    -MMHG-  -DEG C-  -WATTS-  -WATTS-     DC       DC      -KG-  -CU M-  (**)  (***)     -KG-
                         (LB/USE)     (*)   (PSIG)  (DEG F) (BTU/HR) (BTU/HR)  -WATTS-  -WATTS-   (LBS) (CU FT)                 (LBS)
..........................................................................................................................................

   1      4.000                                                0.       0.       .0       .0       .6     .01    1     5         .0
          1.000                                           (    0.) (    0.)     .0       .0   (  1.3) (  .29)              (     .0)

   2      4.000                                                0.       0.       .0       .0       .1     .00    1     5         .0
           .000                                           (    0.) (    0.)     .0       .0   (   .3) (  .03)              (     .0)


APPLIANCE
CONCEPT
  NO.        CONCEPT  NAME

   1  -   EXER-GYM
   2  -   HAND EXERCISER
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TABLE 3-29

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 5.1.1 •••• AUTOCLAVES (SHUTTLE)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	1.000 .500	2	.0603 (.1330)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	308. (1053.)	1520.0 .0	845.0 .0	14.9 (32.8)	.16 (5.59)	1	25	.0 (.0)
		9	.0717 (.1580)	4.54 (10.00)	1551.4 (30.0)	21.1 (70.0)									
2	1.000 2.330						0. (0.)	421. (1438.)	800.0 .0	259.0 .0	10.9 (24.0)	.14 (4.78)	1	25	.0 (.0)
3	1.000 20.100	2	.0603 (.1330)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	112. (381.)	230.0 .0	171.0 .0	39.0 (86.0)	.17 (6.09)	2	45	.0 (.0)
		5	.0014 (.0030)	.00 (.00)	.0 (.0)	.0 (.0)									

APPLIANCE CONCEPT NO.	CONCEPT NAME
1	MOIST HEAT
2	DRY HEAT
3	ETHYLENE OXIDE

(*)

1 -	CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 -	CABIN AIR	(LOST),	KG/HR	(LB/HR)
3 -	OXYGEN	(LOST),	KG/HR	(LB/HR)
4 -	COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 -	WATER	(LOST),	KG/HR	(LB/HR)
6 -	NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 -	NITROGEN	(USED),	KG/HR	(LB/HR)
8 -	FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 -	WATER	(PROCESSED),	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

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TABLE 3-30

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 1.1.1 •••• AMBIENT FOOD STORAGE (SPACE STATION)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	.000 .000						0. (0.)	0. (0.)	.0 .0	.0 .0	93.4 (206.0)	10.51 (371.00)	1	0	.0 (.0)
2	.000 .000						0. (0.)	0. (0.)	.0 .0	.0 .0	.0 (20.6)	.00 (268.00)	1	10	.0 (.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	RIGID
2 -	FLEXIBLE

(*)

1 - CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 - CABIN AIR	(LOST),	KG/HR	(LB/HR)
3 - OXYGEN	(LOST),	KG/HR	(LB/HR)
4 - COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 - WATER	(LOST),	KG/HR	(LB/HR)
6 - NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 - NITROGEN	(USED),	KG/HR	(LB/HR)
8 - FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 - WATER	(PROCESSED),	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

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TABLE 3-31

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 1.1.2 .... REFRIGERATED FOOD STORAGE (SPACE STATION)

CONCEPT NO.	USAGE TIME USES/DAY HRS/USE	CONSUMABLES AND FLOW REQUIREMENTS TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	THERMAL REQMTS COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	ELEC PWR REQMTS PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WT/VOL REQMTS WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	DEVELOPMENT COST AVAIL (**)	INDEX (***)	RESUPPLY WEIGHT -KG- (LBS)
1	.000 .000	8	.0000 (.0000)	.00 (.00)	.0 (.0)	4.4 (40.0)	52. (179.)	0. (0.)	50.0 .0	.0 .0	136.1 (300.0)	.62 (22.00)	1	0	.0 (.0)
2	.000 .000						130. (443.)	-9. (-30.)	.0 225.0	.0 .0	152.9 (337.0)	.71 (25.10)	2	25	.0 (.0)
3	.000 .000						2061. (7039.)	635. (2168.)	11000.0 .0	.0 .0	235.9 (520.0)	2.04 (72.00)	3	70	.0 (.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	SPACE RADIATOR
2 -	THERMOELECTRIC
3 -	AIR CYCLE-TURBINE/COMPRESSOR

(*)

1 -	CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 -	CABIN AIR	(LOST),	KG/HR	(LB/HR)
3 -	OXYGEN	(LOST),	KG/HR	(LB/HR)
4 -	COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 -	WATER	(LOST),	KG/HR	(LB/HR)
6 -	NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 -	NITROGEN	(USED),	KG/HR	(LB/HR)
8 -	FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 -	WATER	(PROCESSED),	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-32

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 1.1.3 .... FROZEN FOOD STORAGE (SPACE STATION)

CONCEPT NO.	USAGE TIME USES/DAY HRS/USE	CONSUMABLES AND FLOW REQUIREMENTS TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	THERMAL REQMTS COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	ELEC PWR REQMTS PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WT/VOL REQMTS WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	DEVELOPMENT COST AVAIL (**)	INDEX (***)	RESUPPLY WEIGHT -KG- (LBS)
1	.000 .000	8	.0000 (.0000)	.00 (.00)	.0 (.0)	-23.3 (-10.0)	716. (2442.)	-665. (-2271.)	50.0 .0	.0 .0	589.7 (1300.0)	2.70 (95.50)	1	0	.0 (.0)
2	.000 .000						7889. (26940.)	1915. (6538.)	.0 11240.0	.0 .0	1476.9 (3256.0)	5.06 (178.70)	2	25	.0 (.0)
3	.000 .000						8679. (29638.)	4292. (4658.)	16700.0 .0	.0 .0	824.2 (1817.0)	5.25 (185.50)	3	70	.0 (.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1	SPACE RADIATOR
2	THERMOELECTRIC
3	AIR CYCLE

(*)

1 - CABIN AIR (CIRCULATED), LITERS/SEC (FT^3/MIN)
2 - CABIN AIR (LOST), KG/HR (LB/HR)
3 - OXYGEN (LOST), KG/HR (LB/HR)
4 - COOLING WATER (CIRCULATED), KG/HR (LB/HR)
5 - WATER (LOST), KG/HR (LB/HR)
6 - NITROGEN (CIRCULATED), KG/HR (LB/HR)
7 - NITROGEN (USED), KG/HR (LB/HR)
8 - FREON (CIRCULATED), KG/HR (LB/HR)
9 - WATER (PROCESSED), KG/HR (LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

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TABLE 3-33

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 1.2.2 •••• FOOD WARMING (SPACE STATION)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE. (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	3.000 2.000						0. (0.)	295. (1007.)	.0 990.0	.0 295.0	54.9 (121.0)	.20 (7.20)	0	5	.0 (.0)
2	3.000 .500						0. (0.)	514. (1755.)	.0 1287.0	.0 1030.0	37.0 (81.5)	.17 (5.90)	0	30	.0 (.0)
3	3.000 .167						0. (0.)	1028. (3510.)	4120.0 .0	4120.0 .0	56.2 (124.0)	.20 (7.10)	0	30	.0 (.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1	HEATING TRAYS (SKYLAB)
2	OVEN-HOT AIR CONVECTION (ELECTRICAL HEAT)
3	OVEN-MICROWAVE (PLAIN)

(*)

1 - CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 - CABIN AIR	(LOST) ,	KG/HR	(LB/HR)
3 - OXYGEN	(LOST) ,	KG/HR	(LB/HR)
4 - COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 - WATER	(LOST) ,	KG/HR	(LB/HR)
6 - NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 - NITROGEN	(USED) ,	KG/HR	(LB/HR)
8 - FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 - WATER	(PROCESSED) ,	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-34

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 1.3.1 •••• DISH WASHER/DRYER COMBINATION (SPACE STATION)

CONCEPT NO.	USAGE TIME USES/DAY HRS/USE	CONSUMABLES AND FLOW REQUIREMENTS TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	THERMAL REQMTS COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	ELEC PWR REQMTS PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WT/VOL REQMTS WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	DEVELOPMENT COST AVAIL (**)	INDEX (***)	RESUPPLY WEIGHT -KG- (LBS)
1	3.000 2.000	9	13.6080 (30.0000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	371. (1268.)	150.0 75.0	.0 .0	71.9 (158.6)	.69 (24.50)	3	65	7.7 (17.0)
2	3.000 2.000	9	13.6080 (30.0000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	1351. (4612.)	1350.0 75.0	.0 .0	68.8 (151.6)	.75 (26.50)	3	60	7.7 (17.0)
3	3.000 2.000	9	13.6080 (30.0000)	.00 (.00)	.0 (.0)	.0 (.0)	247. (842.)	371. (1268.)	167.0 326.0	.0 .0	81.5 (179.6)	.69 (24.50)	3	50	7.7 (17.0)
4	3.000 2.000	9	13.6080 (30.0000)	.00 (.00)	.0 (.0)	.0 (.0)	97. (331.)	368. (1258.)	174.0 145.0	.0 .0	77.8 (171.6)	.76 (27.00)	3	75	7.7 (17.0)
5	3.000 2.000	9	13.6080 (30.0000)	.00 (.00)	.0 (.0)	.0 (.0)	393. (1342.)	255. (871.)	186.0 72.0	.0 .0	97.3 (214.6)	.74 (26.00)	3	75	7.7 (17.0)
6	3.000 2.000	9	13.6080 (30.0000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	618. (2111.)	250.0 72.0	.0 .0	82.4 (181.6)	.72 (25.50)	3	70	7.7 (17.0)
7	3.000 2.000	9	13.6080 (30.0000)	.00 (.00)	.0 (.0)	.0 (.0)	247. (842.)	621. (2121.)	250.0 326.0	.0 .0	88.3 (194.6)	.74 (26.00)	3	65	7.7 (17.0)
8	3.000 2.000	9	13.6080 (30.0000)	.00 (.00)	.0 (.0)	.0 (.0)	97. (331.)	677. (2311.)	250.0 145.0	.0 .0	86.5 (190.6)	.79 (28.00)	3	75	7.7 (17.0)
9	3.000 2.000	9	13.6080 (30.0000)	.00 (.00)	.0 (.0)	.0 (.0)	393. (1342.)	255. (871.)	250.0 72.0	.0 .0	107.3 (236.6)	.76 (27.00)	3	75	7.7 (17.0)
10	3.000 2.000	9	13.6080 (30.0000)	.00 (.00)	.0 (.0)	.0 (.0)	59. (203.)	351. (1200.)	22.0 68.0	.0 .0	48.3 (106.6)	.43 (15.30)	3	35	7.7 (17.0)

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TABLE 3-34 (concluded)

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	-	HOT WATER SPRAY-CENTRIFUGE DRYING
2	-	HOT WATER SPRAY-AIR SPRAY DRY
3	-	HOT WATER SPRAY-FORCED HOT AIRELECTIICHEAT DRY
4	-	HOT WATER SPRAY-DESICCANT ELECTRICALLY DESORBED
5	-	HOT WATER SPRAY-FORCED HOT AIR DRY-THERMAL STORAGE
6	-	ULTRASONIC WASH-CENTRIFUGE DRYING
7	-	ULTRASONIC WASH-FORCRD HOT AIR DRYING
8	-	ULTRASONIC WASH-FORCED COLD DRY AIR-DESICCANT,ELECTRICALLY DESORBED
9	-	ULTRASONIC WASH-FORCED HOT AIR DRY-THERMAL STORAGE
10	-	MANUAL WASH-MANUAL WIPE DRY

(*)

1 -	CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 -	CABIN AIR	(LOST) ,	KG/HR	(LB/HR)
3 -	OXYGEN	(LOST) ,	KG/HR	(LB/HR)
4 -	COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 -	WATER	(LOST) ,	KG/HR	(LB/HR)
6 -	NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 -	NITROGEN	(USED) ,	KG/HR	(LB/HR)
8 -	FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 -	WATER	(PROCESSED) ,	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-35

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 1.3.2 .... DISH WASHER/DRYER WITH DISPOSABLES (SPACE STATION)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	3.000 2.000	9	13.6080 (30.0000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	371. (1268.)	150.0 75.0	.0 .0	71.9 (158.6)	.69 (24.50)	0	65	7.7 (17.0)
2	3.000 2.000	9	13.6080 (30.0000)	.00 (.00)	.0 (.0)	.0 (.0)	247. (842.)	371. (1268.)	167.0 326.0	.0 .0	81.5 (179.6)	.69 (24.50)	0	50	7.7 (17.0)
3	3.000 2.000	9	13.6080 (30.0000)	.00 (.00)	.0 (.0)	.0 (.0)	97. (331.)	368. (1258.)	174.0 162.0	.0 .0	77.8 (171.6)	.76 (27.00)	0	75	7.7 (17.0)
4	3.000 2.000	9	13.6080 (30.0000)	.00 (.00)	.0 (.0)	.0 (.0)	59. (203.)	351. (1200.)	22.0 68.0	.0 .0	48.3 (106.6)	.43 (15.30)	0	35	7.7 (17.0)
5	.000 .000						0. (0.)	0. (0.)	.0 .0	.0 .0	230.5 (508.2)	2.39 (84.50)	0	10	230.5 (508.2)
6	.000 .000						0. (0.)	0. (0.)	.0 .0	.0 .0	265.9 (586.2)	6.12 (216.00)	0	10	265.9 (586.2)
7	.000 .000						0. (0.)	0. (0.)	.0 .0	.0 .0	230.9 (509.0)	2.65 (93.70)	0	10	230.9 (509.1)
8	.000 .000						0. (0.)	0. (0.)	.0 .0	.0 .0	266.3 (587.0)	6.37 (225.00)	0	10	266.3 (587.1)
9	.000 .000						0. (0.)	0. (0.)	.0 .0	.0 .0	156.9 (346.0)	.27 (9.70)	0	10	157.0 (346.2)
10	.000 .000						0. (0.)	0. (0.)	.0 .0	.0 .0	192.3 (424.0)	3.99 (141.00)	0	10	192.4 (424.2)
11	.000 .000						0. (0.)	0. (0.)	.0 .0	.0 .0	157.4 (347.0)	.54 (18.90)	0	10	157.4 (347.1)
12	.000 .000						0. (0.)	0. (0.)	.0 .0	.0 .0	192.8 (425.0)	4.25 (150.00)	0	10	192.8 (425.1)

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TABLE 3-35 (concluded)

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	-	HOT WATER SPRAY-CENTRIFUGE DRYING
2	-	HOT WATER SPRAY-FORCED HOT AIR ELECTRIC HEAT DRYING
3	-	HOT WATER SPRAY-FORCED AIR/DISICCANT/ELECTRICALLY HEATED
4	-	MANUAL WASH-MANUAL WIPE
5	-	DISPOSABLE CUPS-REUSABLE METALLIC UTENSILS AND DISHES
6	-	DISPOSABLE CUPS AND NONMETALLIC DISHES-REUSABLE METALLIC UTENSILS
7	-	DISPOSABLE CUPS AND NONMETALLIC UTENSILS-REUSABLE METALLIC DISHES
8	-	DISPOSABLE CUPS AND NONMETALLIC UTENSILS AND DISHES
9	-	REUSABLE CUPS AND METALLIC UTENSILS AND DISHES
10	-	REUSABLE CUPS AND METALLIC UTENSILS+DISPOSABLE NONMETALLIC DISHES
11	-	REUSABLE CUPS AND METALLIC DISHES--DISPOSABLE NONMETALLIC UTENSILS
12	-	REUSABLE CUPS-DISPOSABLE NONMETALLIC UTENSILS AND DISHES

(*)

1 -	CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 -	CABIN AIR	(LOST) ,	KG/HR	(LB/HR)
3 -	OXYGEN	(LOST) ,	KG/HR	(LB/HR)
4 -	COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 -	WATER	(LOST) ,	KG/HR	(LB/HR)
6 -	NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 -	NITROGEN	(USED) ,	KG/HR	(LB/HR)
8 -	FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 -	WATER	(PROCESSED) ,	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-36

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 2.1.1 **** FECES COLLECTION/TRANSFER (SPACE STATION)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	6.000 .167	1	.0000 (.0000)	9.44 (20.00)	.0 (.0)	21.1 (70.0)	0. (0.)	200. (683.)	675.0 62.0	440.0 52.0	144.2 (318.0)	.95 (33.70)	2	25	57.6 (127.0)
		6	.0000 (.0000)	.00 (.00)	.0 (.0)	21.1 (70.0)									
2	6.000 .217	1	.0000 (.0000)	9.44 (20.00)	.0 (.0)	21.1 (70.0)	0. (0.)	474. (1619.)	680.0 420.0	440.0 360.0	237.0 (522.6)	1.59 (56.00)	2	30	309.4 (682.2)
		5	1.4969 (3.3000)	88.91 (196.00)	1034.3 (20.0)	32.2 (90.0)									
		6	.0000 (.0000)	.00 (.00)	1551.4 (30.0)	21.1 (70.0)									
3	6.000 .158	1	.0000 (.0000)	9.44 (20.00)	.0 (.0)	21.1 (70.0)	0. (0.)	188. (642.)	400.0 46.0	280.0 36.0	420.9 (928.0)	2.12 (75.00)	2	45	373.3 (823.0)
4	6.000 4.000	1	.0000 (.0000)	9.44 (20.00)	.0 (.0)	21.1 (70.0)	0. (0.)	1499. (5120.)	500.0 1142.0	360.0 1132.0	280.3 (618.0)	5.49 (194.00)	3	60	154.7 (341.0)
5	6.000 4.000	3	.2631 (.5800)	.00 (.00)	.0 (.0)	21.1 (70.0)	0. (0.)	1196. (4085.)	500.0 698.0	360.0 688.0	508.0 (1120.0)	5.34 (188.60)	3	65	364.6 (803.7)
6	6.000 4.000	3	.1225 (.2700)	.00 (.00)	.0 (.0)	21.1 (70.0)	0. (0.)	1498. (5115.)	500.0 1198.0	360.0 1188.0	356.1 (785.0)	4.01 (141.60)	3	70	215.9 (476.0)
7	6.000 2.000	3	.1588 (.3500)	.00 (.00)	62058.0 1200.0)	21.1 (70.0)	0. (0.)	1050. (3586.)	600.0 704.0	380.0 694.0	809.7 (1785.0)	6.42 (226.60)	3	75	237.7 (523.9)
8	6.000 .125	1	.0000 (.0000)	4.25 (9.00)	.0 (.0)	21.1 (70.0)	0. (0.)	808. (2760.)	600.0 255.0	380.0 245.0	249.9 (551.0)	.81 (28.70)	1	10	154.7 (341.0)
9	6.000 1.000						0. (0.)	0. (0.)	.0 .0	.0 .0	122.2 (269.4)	.54 (19.00)	1	0	122.0 (269.0)

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TABLE 3-36 (concluded)

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	-	DRY JOHN
2	-	DRY JOHN-ANAL WASH
3	-	GERMICIDE
4	-	INTEGRATED VACUUM DECOMPOSITION
5	-	FLUSH FLOW OXYGEN INCINERATION
6	-	PYROLYSIS/BATCH INCINERATION
7	-	WET OXIDIZATION
8	-	SEMIAUTOMATIC BAG SYSTEM (SKYLAB)
9	-	DRY BAGS (APOLLO)

(*)

1 - CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 - CABIN AIR	(LOST) ,	KG/HR	(LB/HR)
3 - OXYGEN	(LOST) ,	KG/HR	(LB/HR)
4 - COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 - WATER	(LOST) ,	KG/HR	(LB/HR)
6 - NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 - NITROGEN	(USED) ,	KG/HR	(LB/HR)
8 - FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 - WATER	(PROCESSED) ,	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-37

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 2.3.2 **** URINE COLLECTION/TRANSFER (SPACE STATION)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	42.000	1	.0000	9.44	.0	21.1	0.	248.	226.0	114.0	146.5	.25	2	50	92.3
	.017		(.0000)	(20.00)	(.0)	(70.0)	(0.)	(846.)	18.0	18.0	(322.9)	(8.67)			(203.4)
		5	.3629	87.09	1551.4	32.2									
			(.8000)	(192.00)	(30.0)	(90.0)									
2	42.000	1	.0000	9.44	.0	21.1	0.	229.	226.0	114.0	103.1	.50	2	25	62.2
	.017		(.0000)	(20.00)	(.0)	(70.0)	(0.)	(781.)	18.0	18.0	(227.2)	(17.50)			(137.2)
		5	.1497	36.29	1551.4	32.2									
			(.3300)	(80.00)	(30.0)	(90.0)									
3	42.000	1	.0000	9.44	.0	21.1	0.	229.	226.0	114.0	119.4	.18	1	10	99.6
	.017		(.0000)	(20.00)	(.0)	(70.0)	(0.)	(781.)	18.0	18.0	(263.2)	(6.31)			(219.6)
		5	.1497	36.29	1551.4	32.2									
			(.3300)	(80.00)	(30.0)	(90.0)									
4	42.000	1	.0000	9.44	.0	21.1	0.	229.	215.0	110.0	82.8	.09	2	35	62.2
	.017		(.0000)	(20.00)	(.0)	(70.0)	(0.)	(781.)	10.0	10.0	(182.5)	(3.15)			(137.2)
		5	.1497	36.29	1551.4	32.2									
			(.3300)	(80.00)	(30.0)	(90.0)									
5	42.000	2	.4536	.35	.0	21.1	0.	0.	.0	.0	3513.0	.17	1	10	3432.1
	.029		(1.0000)	(.77)	(.0)	(70.0)	(0.)	0.)	.0	.0	(7744.8)	(6.06)			(7566.4)

OK

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	STANDUP URINAL
2 -	COMMODE URINAL
3 -	INTIMATE MALE ADAPTER (SKYLAB)
4 -	APERTURE URINAL
5 -	LIQUID/GAS FLOW CUFF TYPE (APOLLO)

(*)

1 -	CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 -	CABIN AIR	(LOST) ,	KG/HR	(LB/HR)
3 -	OXYGEN	(LOST) ,	KG/HR	(LB/HR)
4 -	COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 -	WATER	(LOST) ,	KG/HR	(LB/HR)
6 -	NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 -	NITROGEN	(USED) ,	KG/HR	(LB/HR)
8 -	FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 -	WATER	(PROCESSED) ,	KG/HR	(LB/HR)

(**)AVAILABLE

(1) AVAILABLE

(2) STATE OF THE ART

(3) SOME DEVELOPMENT REQUIRED

(4) EXTENSIVE DEV. REQUIRED

(***)COST INDICATOR

0-25%

25-50%

50-75%

75-100%

TABLE 3-38

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 2.1.3 •••• VOMITUS COLLECTION/TRANSFER (SPACE STATION)

CONCEPT NO.	USAGE TIME USES/DAY HRS/USE	CONSUMABLES AND FLOW REQUIREMENTS TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	THERMAL REQMTS COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	ELEC PWR REQMTS PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WT/VOL REQMTS WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	DEVELOPMENT COST AVAIL (**)	INDEX (***)	RESUPPLY WEIGHT -KG- (LBS)
1	.840 .015	1	.0000 (.0000)	9.44 (20.00)	.0 (.0)	21.1 (70.0)	0. (0.)	0. (0.)	.0 .0	.0 .0	8.8 (19.3)	.10 (3.48)	2	25	6.9 (15.2)
2	.840 .015	1	.0000 (.0000)	9.44 (20.00)	.0 (.0)	21.1 (70.0)	0. (0.)	0. (0.)	.0 .0	.0 .0	8.3 (18.3)	.07 (2.34)	2	25	7.6 (16.7)
3	.840 .015						0. (0.)	0. (0.)	.0 .0	.0 .0	7.0 (15.5)	.00 (.13)	1	0	6.9 (15.2)
4	.840 .015	1	.0000 (.0000)	9.44 (20.00)	.0 (.0)	21.1 (70.0)	0. (0.)	249. (852.)	250.0 .0	180.0 .0	43.1 (95.1)	.04 (1.57)	2	30	35.0 (77.2)
		5	.2268 (.5000)	24.95 (55.00)	1551.4 (30.0)	21.1 (70.0)									

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	INTIMATE PERSONAL ADAPTOR,DISPOSABLE (MATES WITH COMMODE)
2 -	INTIMATE PERSONAL ADAPTOR,DISPOSABLE (MATES WITH COMMODE)
3 -	PORTABLE DISPOSABLE COLLECTOR (TYPE USE COMMERCIALLY)
4 -	REUSABLE PORTABLE COLLECTOR

(*)
1 - CABIN AIR (CIRCULATED), LITERS/SEC (FT^3/MIN)
2 - CABIN AIR (LOST) , KG/HR (LB/HR)
3 - OXYGEN (LOST) , KG/HR (LB/HR)
4 - COOLING WATER (CIRCULATED), KG/HR (LB/HR)
5 - WATER (LOST) , KG/HR (LB/HR)
6 - NITROGEN (CIRCULATED), KG/HR (LB/HR)
7 - NITROGEN (USED) , KG/HR (LB/HR)
8 - FREON (CIRCULATED), KG/HR (LB/HR)
9 - WATER (PROCESSED) , KG/HR (LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-39

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 2.2.1 •••• WHOLE BODY SHOWER (SPACE STATION)

CONCEPT NO.	USAGE TIME USES/DAY HRS/USE	CONSUMABLES AND FLOW REQUIREMENTS TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	THERMAL REQMTS COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	ELEC PWR REQMTS PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WT/VOL REQMTS WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	DEVELOPMENT COST AVAIL (**)	INDEX (***)	RESUPPLY WEIGHT -KG- (LBS)
1	6.000	1	.0000	21.24	.0	21.1	317.	292.	250.0	16.0	179.5	2.34	0	25	6.4
	.250		(.0000)	(45.00)	(.0)	(70.0)	(1084.)	(997.)	16.0	250.0	(395.7)	(82.57)			(14.1)
		5	2.2680	.00	1551.4	40.6									
			(5.0000)	(.00)	(30.0)	(105.0)									
2	6.000	1	.0000	221.81	.0	21.1	4665.	79.	5370.0	16.0	177.8	2.02	0	40	2.2
	.250		(.0000)	(470.00)	(.0)	(70.0)	(15931.)	(271.)	16.0	5370.0	(392.0)	(71.16)			(4.9)
		5	2.2680	.00	1551.4	40.6									
			(5.0000)	(.00)	(30.0)	(105.0)									
3	6.000	5	2.2680	.00	1551.4	40.6	198.	1576.	536.0	.0	229.0	3.05	0	15	24.0
	.250		(5.0000)	(.00)	(30.0)	(105.0)	(675.)	(5383.)	.0	.0	(504.8)	(107.74)			(52.8)
4	6.000	5	2.7216	.00	1292.9	41.1	77.	292.	85.0	.0	103.8	1.57	0	5	6.9
	.250		(6.0000)	(.00)	(25.0)	(106.0)	(263.)	(997.)	.0	85.0	(228.7)	(55.30)			(15.1)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	VACUUM PICKUP
2 -	AIR DRAG
3 -	MECHANICAL
4 -	COLLAPSIBLE

(*)

1 -	CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 -	CABIN AIR	(LOST) ,	KG/HR	(LB/HR)
3 -	OXYGEN	(LOST) ,	KG/HR	(LB/HR)
4 -	COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 -	WATER	(LOST) ,	KG/HR	(LB/HR)
6 -	NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 -	NITROGEN	(USED) ,	KG/HR	(LB/HR)
8 -	FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 -	WATER	(PROCESSED) ,	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-40

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 2.2.2 •••• PARTIAL BODY WASHING (SPACE STATION)

CONCEPT NO.	USAGE TIME USES/DAY HRS/USE	CONSUMABLES AND FLOW REQUIREMENTS TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	THERMAL REQMTS COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	ELEC PWR REQMTS PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WT/VOL REQMTS WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	DEVELOPMENT COST AVAIL (**)	INDEX (***)	RESUPPLY WEIGHT -KG- (LBS)
1	60.000 .037	2	.0003 (.0007)	.00 (.00)	.0 (.0)	21.1 (70.0)	105. (360.)	278. (948.)	500.0 .0	360.0 .0	338.1 (745.4)	5.72 (202.12)	2	30	296.6 (654.0)
		5	.2268 (.5000)	.01 (.02)	1551.4 (30.0)	.0 (.0)									
2	60.000 .037	5	.3901 (.8600)	.01 (.02)	1551.4 (30.0)	.0 (.0)	105. (360.)	278. (948.)	500.0 .0	360.0 .0	21.6 (47.7)	.15 (5.20)	2	30	4.1 (9.1)
3	60.000 .037						0. (0.)	0. (0.)	.0 .0	.0 .0	587.0 (1294.0)	.84 (29.80)	1	10	576.1 (1270.0)
4	60.000 .037	5	.0227 (.0500)	.00 (.00)	1551.4 (30.0)	.0 (.0)	633. (2160.)	11. (37.)	52.8 .0	32.0 .0	10.1 (22.2)	.05 (1.70)	2	50	.7 (1.6)
5	60.000 .037	5	1.2293 (2.7100)	.00 (.00)	1551.4 (30.0)	.0 (.0)	105. (360.)	311. (1062.)	500.0 .0	360.0 .0	57.9 (127.5)	.58 (20.50)	2	30	18.2 (40.1)
6	60.000 .037	5	.2381 (.5250)	.00 (.00)	1810.0 (35.0)	51.7 (125.0)	32. (110.)	30. (101.)	57.5 140.0	.0 .0	196.5 (433.1)	3.45 (121.80)	1	5	177.9 (392.1)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1	DISPOSABLE WET WIPES
2	REUSABLE WET WIPES
3	DISPOSABLE WIPES (PREPACKAGED)
4	AUTOMATIC SPONGE
5	REUSABLE WASHCLOTHES
6	DISPOSABLE WASHCLOTHES (SKYLAB)

(*)			
1 - CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 - CABIN AIR	(LOST),	KG/HR	(LB/HR)
3 - OXYGEN	(LOST),	KG/HR	(LB/HR)
4 - COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 - WATER	(LOST),	KG/HR	(LB/HR)
6 - NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 - NITROGEN	(USED),	KG/HR	(LB/HR)
8 - FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 - WATER	(PROCESSED),	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

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TABLE 3-41

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 2.2.3 •••• PARTIAL BODY DRYING (SPACE STATION)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	60.000						37.	292.	.0	.0	75.2	.25	1	5	45.3
	.037						(125.)	(997.)	.0	.0	(165.6)	(8.80)			(99.8)
2	60.000						0.	0.	.0	.0	197.0	.86	1	5	179.5
	.037						(0.)	(0.)	.0	.0	(434.2)	(30.30)			(395.7)
3	60.000						0.	76.	1725.0	1725.0	7.3	.02	1	5	.0
	.044						(0.)	(261.)	.0	.0	(16.0)	(.53)			(.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1	REUSABLE DRY WIPES
2	DISPOSABLE DRY WIPES
3	ELECTRIC DRYER

(*)

1 - CABIN AIR (CIRCULATED), LITERS/SEC (FT^3/MIN)
2 - CABIN AIR (LOST) , KG/HR (LB/HR)
3 - OXYGEN (LOST) , KG/HR (LB/HR)
4 - COOLING WATER (CIRCULATED), KG/HR (LB/HR)
5 - WATER (LOST) , KG/HR (LB/HR)
6 - NITROGEN (CIRCULATED), KG/HR (LB/HR)
7 - NITROGEN (USED) , KG/HR (LB/HR)
8 - FREON (CIRCULATED), KG/HR (LB/HR)
9 - WATER (PROCESSED) , KG/HR (LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

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TABLE 3-42

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 2.3.1 •••• SHAVING (SPACE STATION)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	6.000 .100						0. (0.)	0. (0.)	.0 .0	.0 .0	13.2 (29.1)	.04 (1.24)	1	0	9.8 (21.6)
2	6.000 .100						0. (0.)	12. (41.)	30.0 115.0	30.0 .0	3.1 (6.7)	.02 (.62)	1	10	.0 (.0)
3	6.000 .100						0. (0.)	0. (0.)	.0 .0	.0 .0	.5 (1.0)	.00 (.02)	1	0	.0 (.0)
4	6.000 .100						0. (0.)	0. (0.)	.0 .0	.0 .0	.2 (.4)	.00 (.00)	1	10	.0 (.0)
5	6.000 .100						0. (0.)	12. (40.)	30.0 115.0	30.0 .0	13.6 (29.9)	.04 (1.26)	1	15	9.8 (21.6)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1	WET SHAVE WITH SAFETY RAZOR AND CREAM
2	DRY SHAVE-ELECTRIC RAZOR/VACUUM COLLECTION
3	DRY SHAVE-WINDUP RAZOR
4	DRY SHAVE-VACUUM DRIVEN RAZOR
5	WET SHAVE-SAFETY RAZOR/VACUUM

(*)

1 - CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 - CABIN AIR	(LOST)	, KG/HR	(LB/HR)
3 - OXYGEN	(LOST)	, KG/HR	(LB/HR)
4 - COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 - WATER	(LOST)	, KG/HR	(LB/HR)
6 - NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 - NITROGEN	(USED)	, KG/HR	(LB/HR)
8 - FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 - WATER	(PROCESSED)	, KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-43

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 2.3.2 **** HAIR CUTTING (SPACE STATION)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	.430 .024						0. (0.)	33. (114.)	50.0 115.0	50.0 .0	.9 (2.1)	.01 (.25)	1	10	.0 (.0)
2	.430 .099						0. (0.)	3. (11.)	.0 115.0	.0 .0	.7 (1.5)	.01 (.25)	1	10	.0 (.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1	POWER CLIPPER/VACUUM COLLECTION
2	RAZOR COMB/VACUUM COLLECTION

(*)

1 -	CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 -	CABIN AIR	(LOST),	KG/HR	(LB/HR)
3 -	OXYGEN	(LOST),	KG/HR	(LB/HR)
4 -	COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 -	WATER	(LOST),	KG/HR	(LB/HR)
6 -	NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 -	NITROGEN	(USED),	KG/HR	(LB/HR)
8 -	FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 -	WATER	(PROCESSED),	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

ok

73407

TABLE 3-44

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX No. 2.3.3 •••• NAIL CUTTING (SPACE STATION)

CONCEPT NO.	USAGE TIME USES/DAY HRS/USE	CONSUMABLES AND FLOW REQUIREMENTS TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	THERMAL REQMTS COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	ELEC PWR REQMTS PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WT/VOL REQMTS WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	DEVELOPMENT COST AVAIL (**)	INDEX (***)	RESUPPLY WEIGHT -KG- (LBS)
1	.430 .050						0. (0.)	0. (0.)	.0 .0	.0 .0	.2 (.5)	.00 (.00)	1	5	.1 (.1)
2	.430 .050						0. (0.)	2. (6.)	.0 115.0	.0 .0	.8 (1.8)	.00 (.06)	1	20	.0 (.0)

APPLIANCE CONCEPT NO. — CONCEPT NAME

1 - MANUAL NAIL CLIPPER
2 - METAL NAIL FILE-VACUUM COLLECTION

(*)
1 - CABIN AIR (CIRCULATED), LITERS/SEC (FT^3/MIN)
2 - CABIN AIR (LOST) , KG/HR (LB/HR)
3 - OXYGEN (LOST) , KG/HR (LB/HR)
4 - COOLING WATER (CIRCULATED), KG/HR (LB/HR)
5 - WATER (LOST) , KG/HR (LB/HR)
6 - NITROGEN (CIRCULATED), KG/HR (LB/HR)
7 - NITROGEN (USED) , KG/HR (LB/HR)
8 - FREON (CIRCULATED), KG/HR (LB/HR)
9 - WATER (PROCESSED) , KG/HR (LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

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TABLE 3-45

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 2.3.4 .... TEETH BRUSHING (SPACE STATION)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	6.000 .330						0. (0.)	0. (0.)	.0 .0	.0 .0	78.5 (173.0)	.27 (9.60)	1	0	75.3 (166.0)
2	6.000 .330	5	.0567 (.1250)	.68 (1.50)	1551.4 (30.0)	21.1 (70.0)	0. (0.)	8. (27.)	24.0 .0	24.0 .0	1.6 (3.5)	.00 (.09)	1	20	.3 (.6)
3	6.000 .330						0. (0.)	2. (7.)	6.0 .0	6.0 .0	75.4 (166.3)	.13 (4.46)	1	10	75.3 (166.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	TOOTHPASTE WITH DENTIFRICE
2 -	WATER PIX
3 -	ELECTRIC TOOTHBRUSH

(*)

1 -	CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 -	CABIN AIR	(LOST) ,	KG/HR	(LB/HR)
3 -	OXYGEN	(LOST) ,	KG/HR	(LB/HR)
4 -	COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 -	WATER	(LOST) ,	KG/HR	(LB/HR)
6 -	NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 -	NITROGEN	(USED) ,	KG/HR	(LB/HR)
8 -	FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 -	WATER	(PROCESSED) ,	KG/HR	(LB/HR)

ok

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-46

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 3.1.1 **** SURFACE WIPING (SPACE STATION)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	15.000 .037	2 5	.0003 (.0007) .2268 (.5000)	.00 (.00) .00 (.00)	.0 (.0) 1551.4 (30.0)	21.1 (70.0) 21.1 (70.0)	105. (360.)	278. (948.)	500.0 .0	360.0 .0	192.0 (423.3)	5.47 (193.30)	2	30	156.3 (344.6)
2	15.000 .037	2 5	.0003 (.0007) .2812 (.6200)	.00 (.00) .00 (.00)	.0 (.0) 1551.4 (30.0)	.0 (.0) 21.1 (70.0)	105. (360.)	278. (948.)	500.0 .0	360.0 .0	96.8 (213.5)	.24 (8.30)	2	30	80.9 (178.3)
3	15.000 .037						0. (0.)	0. (0.)	.0 .0	.0 .0	351.1 (774.1)	.72 (25.40)	1	10	351.2 (774.2)
4	15.000 .037	5	.2268 (.5000)	.00 (.00)	1551.4 (30.0)	21.1 (70.0)	791. (2700.)	11. (37.)	52.8 .0	31.5 .0	10.5 (23.0)	.05 (1.70)	2	50	1.1 (2.4)
5	15.000 .037	2 5	.0003 (.0007) .2835 (.6250)	.00 (.00) .00 (.00)	.0 (.0) 1551.4 (30.0)	.0 (.0) 21.1 (70.0)	105. (360.)	278. (948.)	500.0 .0	361.0 .0	100.6 (221.8)	.63 (22.20)	2	30	82.5 (181.8)
6	15.000 .037	2 5	.0003 (.0007) .2381 (.5250)	.00 (.00) .00 (.00)	.0 (.0) 1810.0 (35.0)	.0 (.0) 51.7 (125.0)	32. (110.)	30. (101.)	57.5 140.0	57.5 190.0	62.5 (137.8)	1.00 (35.40)	1	5	46.9 (103.3)
7	15.000 .037	2 5	.0003 (.0007) 2.5402 (5.6000)	.00 (.00) .00 (.00)	.0 (.0) 1551.4 (30.0)	21.1 (70.0) 51.7 (125.0)	105. (360.)	278. (948.)	500.0 .0	360.0 .0	129.5 (285.6)	5.45 (192.40)	2	30	82.1 (181.0)
8	15.000 .037	5	2.5946 (5.7200)	.00 (.00)	1551.4 (30.0)	51.7 (125.0)	105. (360.)	278. (948.)	500.0 .0	360.0 .0	33.3 (73.5)	.22 (7.70)	2	30	6.6 (14.5)
9	15.000 .037	5	2.6082 (5.7500)	.00 (.00)	1551.4 (30.0)	51.7 (125.0)	105. (360.)	278. (948.)	500.0 .0	360.0 .0	37.3 (82.2)	.30 (10.70)	2	30	8.3 (18.3)
10	15.000 .037	5	2.5402 (5.6000)	.00 (.00)	1810.0 (35.0)	51.7 (125.0)	32. (110.)	146. (499.)	57.5 140.0	57.5 190.0	91.8 (202.3)	.99 (34.80)	1	5	65.3 (144.0)

ok

TABLE 3-46 (concluded)

11	15.000 .037	5	.2268 (.5000)	.00 (.00)	1551.4 (30.0)	51.7 (125.0)	105. (360.)	278. (948.)	500.0 .0	360.0 .0	40.4 (89.1)	.13 (4.60)	2	30	27.5 (60.6)
12	15.000 .037	5	.2268 (.5000)	.00 (.00)	1551.4 (30.0)	51.7 (125.0)	32. (110.)	30. (101.)	57.5 140.0	57.5 140.0	41.8 (92.1)	.06 (2.20)	1	5	27.5 (60.6)

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	-	DISPOSABLE WET/DRY WIPES
2	-	REUSABLE WET WIPES-DISPOSABLE DRY WIPES
3	-	DISPOSABLE WET/DRY WIPES (PREPACKAGED)
4	-	AUTOMATIC SPONGE MOP
5	-	REUSABLE CLEANING CLOTHS DISPOSABLE DRY WIPES
6	-	DISPOSABLE CLEANING CLOTHS (SKLAB) DISPOSABLE DRY WIPES
7	-	DISPOSABLE WET WIPES REUSABLE DRY WIPES
8	-	REUSABBLE WET/DRY WIPES
9	-	REUSABLE CLEANING CLOTHS/DRY WIPES
10	-	DISPOSABLE CLEANING CLOTHS REUSABLE DRY WIOES
11	-	SPONGES/ENCLOSED WETTING UNIT
12	-	SPONGES/SKYLAB TYPE WETTING UNIT

(*)

1 -	CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 -	CABIN AIR	(LOST) ,	KG/HR	(LB/HR)
3 -	OXYGEN	(LOST) ,	KG/HR	(LB/HR)
4 -	COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 -	WATER	(LOST) ,	KG/HR	(LB/HR)
6 -	NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 -	NITROGEN	(USED) ,	KG/HR	(LB/HR)
8 -	FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 -	WATER	(PROCESSED) ,	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-47

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 3.2.1 **** MANUAL REFUSE COLLECTION (SPACE STATION)

CONCEPT NO.	USAGE TIME USES/DAY HRS/USE	CONSUMABLES AND FLOW REQUIREMENTS TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	THERMAL REQMTS COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	ELEC PWR REQMTS PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WT/VOL REQMTS WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	DEVELOPMENT COST AVAIL (**)	INDEX (***)	RESUPPLY WEIGHT -KG- (LBS)
1	.000 .000						0. (0.)	0. (0.)	.0 .0	.0 .0	153.1 (337.6)	.64 (22.51)	1	5	142.4 (314.0)
2	.000 .000						0. (0.)	0. (0.)	.0 .0	.0 .0	151.5 (334.0)	1.56 (55.14)	1	20	110.2 (243.0)
3	.000 .000						0. (0.)	0. (0.)	.0 .0	.0 .0	152.5 (336.1)	.96 (33.97)	1	20	144.2 (318.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1	DISPOSABLE TRASH BAG
2	REUSABLE WASTE RECEPTICLES
3	DISPOSABLE WASTE RECEPTICLES

(*)

1	CABIN AIR	(CIRCULATED)	LITERS/SEC	(FT^3/MIN)
2	CABIN AIR	(LOST)	KG/HR	(LB/HR)
3	OXYGEN	(LOST)	KG/HR	(LB/HR)
4	COOLING WATER	(CIRCULATED)	KG/HR	(LB/HR)
5	WATER	(LOST)	KG/HR	(LB/HR)
6	NITROGEN	(CIRCULATED)	KG/HR	(LB/HR)
7	NITROGEN	(USED)	KG/HR	(LB/HR)
8	FREON	(CIRCULATED)	KG/HR	(LB/HR)
9	WATER	(PROCESSED)	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

ok

TABLE 3-48

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 3.2.2 .... VACUUM REFUSE COLLECTION (SPACE STATION)

CONCEPT NO.	USAGE TIME: USES/DAY HRS/USE	CONSUMABLES AND FLOW REQUIREMENTS: TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	THERMAL REQMTS: COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	ELEC PWR REQMTS: PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WT/VOL REQMTS: WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	DEVELOPMENT COST: AVAIL (**)	INDEX (***)	RESUPPLY: WEIGHT -KG- (LBS)
1	5.000 .082						0. (0.)	77. (262.)	.0 115.0	.0 .0	13.8 (30.4)	.02 (.86)	1	5	.2 (.4)
2	5.000 .082						0. (0.)	160. (546.)	240.0 .0	.0 .0	4.7 (10.4)	.01 (.37)	1	20	.2 (.4)
3	5.000 .082	3	.6219 (1.3700)	4.59 (10.00)	.0 (.0)	21.1 (70.0)	0. (0.)	0. (0.)	.0 .0	.0 .0	574.9 (1267.4)	.01 (.26)	1	25	559.3 (1233.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	VACUUM CLEANER (SKYLAB)
2 -	VACUUM CLEANER (COMMERICAL)
3 -	VACUUM CLEANER-VENTED TO SPACE

(*)

1 -	CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 -	CABIN AIR	(LOST) ,	KG/HR	(LB/HR)
3 -	OXYGEN	(LOST) ,	KG/HR	(LB/HR)
4 -	COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 -	WATER	(LOST) ,	KG/HR	(LB/HR)
6 -	NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 -	NITROGEN	(USED) ,	KG/HR	(LB/HR)
8 -	FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 -	WATER	(PROCESSED) ,	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

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TABLE 3-49

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 3.2.9 •••• REFUSE PROCESSING (SPACE STATION)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (•)	AMT. USED -KG/USE- (LB/USE)	FLOW • (•)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (••)	INDEX (•••)	WEIGHT -KG- (LBS)
1	5.200 .017	1	.0000 (.0000)	.00 (.00)	1810.0 (35.0)	21.1 (70.0)	0. (0.)	0. (0.)	.0 10.0	.0 10.0	55.9 (123.2)	.21 (7.41)	2	30	21.5 (47.3)
2	5.200 .017	2	.0163 (.0360)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	0. (0.)	.0 10.0	.0 10.0	87.8 (193.5)	.31 (10.95)	2	30	52.6 (116.1)
3	5.200 .017						0. (0.)	50. (169.)	745.0 .0	745.0 .0	58.2 (128.2)	.21 (7.40)	2	30	21.5 (47.3)
4	24.300 .017						0. (0.)	0. (0.)	.0 .0	.0 .0	33.7 (74.4)	.53 (18.81)	2	50	21.5 (47.3)
5	5.200 .017	1	.0000 (.0000)	.00 (.00)	1810.0 (35.0)	21.1 (70.0)	0. (0.)	149. (509.)	745.0 10.0	745.0 10.0	89.9 (198.2)	.25 (9.00)	2	40	21.5 (47.3)
6	5.200 .017	2	.0163 (.0360)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	149. (509.)	745.0 10.0	745.0 .0	105.5 (232.5)	.25 (9.00)	2	40	36.7 (80.9)
7	5.200 .017						0. (0.)	199. (678.)	1490.0 746.0	.0 .0	92.2 (203.2)	.25 (9.00)	2	40	21.5 (47.3)
8	24.300 .017						0. (0.)	149. (509.)	745.0 .0	745.0 .0	67.8 (149.4)	.58 (20.40)	2	40	21.5 (47.3)
9	2.000 12.000	1	.0000 (.0000)	9.44 (20.00)	.0 (.0)	.0 (.0)	0. (0.)	1394. (4760.)	1400.0 .0	.0 .0	122.8 (270.7)	2.14 (75.40)	3	60	41.6 (91.7)
10	2.000 12.000	3	.5820 (1.2830)	.00 (.00)	.0 (.0)	21.1 (70.0)	0. (0.)	999. (3410.)	1000.0 .0	.0 .0	341.4 (752.7)	2.05 (72.50)	3	65	251.5 (554.4)
11	2.000 12.000	3	.1706 (.3760)	.00 (.00)	.0 (.0)	21.1 (70.0)	0. (0.)	1394. (4760.)	1400.0 .0	.0 .0	189.8 (418.4)	1.62 (57.20)	3	70	103.1 (227.4)
12	2.000 12.000	3	.2291 (.5050)	.00 (.00)	62058.0 1200.0)	21.1 (70.0)	0. (0.)	899. (3070.)	900.0 .0	.0 .0	366.0 (806.8)	2.44 (86.20)	3	75	124.4 (274.2)

TABLE 3-49 (concluded)

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	-	COMPACTOR-AIR PRESSURE
2	-	COMPACTOR-VACUUM
3	-	COMPACTOR-MOTOR
4	-	COMPACTOR-MANUAL
5	-	COMPACTOR-AIR PRESSURE W/SHREDDER
6	-	COMPACTOR-VACUUM W/SHREDDER
7	-	COMPACTOR-MOTOR W/SHREDDER
8	-	COMPACTOR-MANUAL W/SHREDDER
9	-	INTEGRATED VACUUM DECOMPOSTION/SHREDDER
10	-	FLUSH FLOW OXYGEN INCINERATION/SHREDDER
11	-	PYROLYSIS/BATCH INCINERATION/SHREDDER
12	-	WET OXIDIZATION/ SHREDDER

(*)

1 -	CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 -	CABIN AIR	(LOST),	KG/HR	(LB/HR)
3 -	OXYGEN	(LOST),	KG/HR	(LB/HR)
4 -	COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 -	WATER	(LOST),	KG/HR	(LB/HR)
6 -	NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 -	NITROGEN	(USED),	KG/HR	(LB/HR)
8 -	FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 -	WATER	(PROCESSED),	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-50

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX No. 3.2.5 •••• REFUSE DISPOSAL (SPACE STATION)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	1.000 .032	2	.3039 (.6700)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	0. (0.)	.0 .0	.0 .0	235.9 (520.0)	16.62 (587.00)	1	10	54.6 (120.3)
2	1.000 .032						0. (0.)	0. (0.)	.0 .0	.0 .0	44.3 (97.6)	16.57 (585.00)	1	10	.8 (1.9)
3	1.000 .001						0. (0.)	0. (0.)	.0 10.0	.0 .0	248.6 (548.0)	.73 (25.90)	2	35	191.1 (421.4)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1	VACUUM STORAGE
2	STORAGE BIN/CONTAINER
3	SOLID PROPELLANT REFUSE ROCKET

(*)

1 -	CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 -	CABIN AIR	(LOST) ,	KG/HR	(LB/HR)
3 -	OXYGEN	(LOST) ,	KG/HR	(LB/HR)
4 -	COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 -	WATER	(LOST) ,	KG/HR	(LB/HR)
6 -	NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 -	NITROGEN	(USED) ,	KG/HR	(LB/HR)
8 -	FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 -	WATER	(PROCESSED) ,	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

ok

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TABLE 3-51

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 3.3.1 **** GARMENT/LINEN WASHING (SPACE STATION)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	2.000 1.000	9	49.8960 (10.0000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	1458. (4980.)	225.0 .0	.0 .0	159.9 (352.5)	.51 (18.10)	0	70	18.9 (41.6)
2	2.000 1.000	9	49.8960 (10.0000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	1470. (5020.)	237.0 .0	.0 .0	156.7 (345.5)	.54 (19.10)	0	60	18.9 (41.6)
3	2.000 1.000	9	49.8960 (10.0000)	.00 (.00)	.0 (.0)	.0 (.0)	593. (2025.)	1385. (4728.)	216.0 681.0	.0 .0	261.0 (575.5)	2.04 (71.90)	0	90	18.9 (41.6)
4	2.000 1.000	9	49.8960 (10.0000)	.00 (.00)	.0 (.0)	.0 (.0)	593. (2025.)	1352. (4618.)	216.0 681.0	.0 .0	265.1 (584.5)	2.04 (71.90)	0	90	18.9 (41.6)
5	2.000 1.000	7	.1361 (.3000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	1308. (4468.)	75.0 .0	.0 .0	188.9 (416.5)	.44 (15.70)	0	95	67.7 (149.2)
		9	49.8960 (10.0000)	.00 (.00)	.0 (.0)	.0 (.0)									
6	2.000 1.000	7	.1769 (.3900)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	1308. (4468.)	75.0 .0	.0 .0	197.1 (434.5)	.43 (15.20)	0	95	82.3 (181.5)
		9	49.8960 (10.0000)	.00 (.00)	.0 (.0)	.0 (.0)									
7	2.000 1.000	9	49.8960 (10.0000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	1470. (5020.)	237.0 .0	.0 .0	159.9 (352.5)	.53 (18.60)	0	90	18.9 (41.6)
8	2.000 1.000	9	49.8960 (10.0000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	2770. (9460.)	1537.0 .0	.0 .0	166.7 (367.5)	.57 (20.10)	0	60	18.9 (41.6)
9	2.000 1.000	9	49.8960 (10.0000)	.00 (.00)	.0 (.0)	.0 (.0)	395. (1350.)	254. (868.)	144.0 454.0	.0 .0	117.8 (259.6)	1.22 (43.10)	0	50	16.8 (37.0)
10	2.000 1.000	9	49.8960 (10.0000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	1470. (5020.)	237.0 .0	.0 .0	159.9 (352.5)	.53 (18.60)	0	50	18.9 (41.6)

TABLE 3-51 (concluded)

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	-	MECHANICAL OSCILLATION
2	-	FLUIDIC AGITATION
3	-	PISTON AGITATION
4	-	CYCLIC VALVE AND PUMP AGITATION
5	-	DIAPHRAM ACTUATED-ONE DIRECTIONAL SQUEEZE
6	-	DIAPHRAM ACTUATED-TWO DIRECTIONAL SQUEEZE
7	-	WATER SPRAY AGITATED
8	-	ULTRASONIC
9	-	MANUAL WASHBOARD
10	-	PLAIN RECIRCULATION

(*)

1 - CABIN AIR (CIRCULATED), LITERS/SEC (FT^3/MIN)
2 - CABIN AIR (LOST), KG/HR (LB/HR)
3 - OXYGEN (LOST), KG/HR (LB/HR)
4 - COOLING WATER (CIRCULATED), KG/HR (LB/HR)
5 - WATER (LOST), KG/HR (LB/HR)
6 - NITROGEN (CIRCULATED), KG/HR (LB/HR)
7 - NITROGEN (USED), KG/HR (LB/HR)
8 - FREON (CIRCULATED), KG/HR (LB/HR)
9 - WATER (PROCESSED), KG/HR (LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-52

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 3.3.2 **** GARMENT/LINEN DRYING (SPACE STATION)

CONCEPT NO. ***	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	2.000 4.000						198. (675.)	106. (363.)	72.0 227.0	.0 .0	36.3 (80.0)	.50 (17.60)	2	30	.0 (.0)
2	2.000 4.000						328. (1120.)	151. (515.)	93.0 .0	.0 .0	81.6 (180.0)	.64 (22.70)	3	65	.0 (.0)
3	2.000 4.000	2	.0021 (.0047)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	95. (325.)	137.0 .0	.0 .0	214.0 (471.7)	.95 (33.71)	3	60	131.2 (289.3)
		5	.3629 (.8000)	.00 (.00)	.0 (.0)	.0 (.0)									
4	2.000 4.000						88. (300.)	95. (325.)	137.0 101.0	.0 .0	34.9 (77.0)	.51 (17.90)	3	60	.0 (.0)
5	2.000 3.175	2	.0345 (.0760)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	0. (0.)	55.0 .0	.0 .0	212.7 (469.0)	.61 (21.51)	2	30	142.9 (315.0)
		5	.3629 (.8000)	.00 (.00)	.0 (.0)	.0 (.0)									
6	2.000 4.000	2	.0345 (.0760)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	13. (45.)	55.0 90.0	.0 .0	219.5 (484.0)	.64 (22.51)	2	35	142.9 (315.0)
		5	.3629 (.8000)	.00 (.00)	.0 (.0)	.0 (.0)									
7	2.000 4.000	2	.0345 (.0760)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	13. (45.)	55.0 .0	.0 .0	226.3 (499.0)	.68 (24.01)	3	70	142.9 (315.0)
		5	.3629 (.8000)	.00 (.00)	.0 (.0)	.0 (.0)									
8	2.000 8.000						0. (0.)	46. (157.)	7.0 .0	.0 .0	22.7 (50.0)	3.68 (130.00)	1	5	.0 (.0)
9	2.000 4.000						0. (0.)	259. (883.)	3.0 256.0	.0 .0	18.1 (40.0)	3.96 (140.00)	1	10	.0 (.0)

TABLE 3-52 (concluded)

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	-	FORCED HOT AIR-ELECTRIC
2	-	FORCED HOT AIR-HEAT FROM THERMAL STORAGE UNIT
3	-	FORCED COLD DRY AIR-DISICCANT(VACUUM REGENERABLE)
4	-	FORCED COLD DRY AIR-DISICCANT(ELECTRIC HEAT REGENERABLE)
5	-	VACUUM DRY
6	-	THERMAL VACUUM DRY-ELECTRIC HEAT
7	-	THERMAL VACUUM DRY-THERMAL STORAGE/RADIANT HEAT
8	-	CLOTHES LINE-FORCED CONVECTION
9	-	CLOTHES LINE-FORCED CONVECTION+ELECTRIC HEAT

(*)

1 - CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 - CABIN AIR	(LOST) ,	KG/HR	(LB/HR)
3 - OXYGEN	(LOST) ,	KG/HR	(LB/HR)
4 - COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 - WATER	(LOST) ,	KG/HR	(LB/HR)
6 - NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 - NITROGEN	(USED) ,	KG/HR	(LB/HR)
8 - FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 - WATER	(PROCESSED) ,	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-53

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 3.3.3.... GARMENT/LINEN WASHER/DRYER-DISPOSABLE CLOTHES (SPACE STATION)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	2.000 5.000	9	49.8960 (10.0000)	.00 (.00)	.0 (.0)	.0 (.0)	198. (675.)	1470. (5020.)	237.0 227.0	.0 .0	236.1 (520.5)	1.32 (46.75)	3	60	18.9 (41.6)
2	2.000 5.000	9	49.8960 (10.0000)	.00 (.00)	.0 (.0)	.0 (.0)	328. (1120.)	1470. (5020.)	237.0 .0	.0 .0	283.7 (625.5)	1.68 (59.45)	3	65	18.9 (41.6)
3	2.000 9.000	9	49.8960 (10.0000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	1470. (5020.)	237.0 .0	.0 .0	328.2 (723.5)	5.01 (176.75)	3	70	18.9 (41.6)
4	2.000 5.000	9	49.8960 (10.0000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	1470. (5020.)	237.0 256.0	.0 .0	323.6 (713.5)	5.29 (186.75)	3	60	18.9 (41.6)
5	2.000 5.000	9	49.8960 (10.0000)	.00 (.00)	.0 (.0)	.0 (.0)	198. (675.)	1470. (5020.)	237.0 227.0	.0 .0	239.3 (527.5)	1.31 (46.25)	2	90	18.9 (41.6)
6	2.000 5.000	9	49.8960 (10.0000)	.00 (.00)	.0 (.0)	.0 (.0)	328. (1120.)	1470. (5020.)	237.0 .0	.0 .0	286.9 (632.5)	1.66 (58.45)	3	65	18.9 (41.6)
7	2.000 9.000	9	49.8960 (10.0000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	1470. (5020.)	237.0 .0	.0 .0	243.8 (537.5)	4.99 (176.25)	3	70	18.9 (41.6)
8	2.000 5.000	9	49.8960 (10.0000)	.00 (.00)	.0 (.0)	.0 (.0)	0. (0.)	1470. (5020.)	237.0 256.0	.0 .0	239.3 (527.5)	5.27 (186.15)	2	90	18.9 (41.6)
9	.000 .000						0. (0.)	0. (0.)	.0 .0	.0 .0	693.6 (1529.0)	8.21 (290.00)	1	0	678.6 (1496.0)

TABLE 3-53 (concluded)

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	-	FLUIDIC AGITATION/FORCED HOT AIR-ELECTRIC HEATER
2	-	FLUIDIC AGITATION/FORCED HOT AIR-THERMAL STORAGE HEATER
3	-	FLUIDIC AGITATION/FORCED AIR DRYING-CLOTHES LINE
4	-	FLUIDIC AGITATION/FORCED AIR DRYING-CLOTHES LINE
5	-	WATER SPRAY AGITATION/FORCED HOT AIR-ELECTRIC HEATER
6	-	WATER SPRAY AGITATION/FORCED HOT AIR-THERMAL STORAGE HEATER
7	-	WATER SPRAY AGITATION/FORCED AIR DRYING-CLOTHES LINE
8	-	WATER SPRAY AGITATION/ELECTRICALLY HEATED-CLOTHES LINE
9	-	DISPOSABLE CLOTHES

(*)

1 -	CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 -	CABIN AIR	(LOST),	KG/HR	(LB/HR)
3 -	OXYGEN	(LOST),	KG/HR	(LB/HR)
4 -	COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 -	WATER	(LOST),	KG/HR	(LB/HR)
6 -	NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 -	NITROGEN	(USED),	KG/HR	(LB/HR)
8 -	FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 -	WATER	(PROCESSED),	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

TABLE 3-54

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 4.1.1 **** MUSIC (SPACE STATION)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	3.000 2.000						0. (0.)	30. (102.)	30.0 .0	30.0 .0	66.4 (146.4)	.08 (2.98)	1	5	.0 (.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1	CASSETTE PLAYER/RECORDER

TABLE 3-55

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 4.1.2 •••• LIBRARY [SPACE STATION]

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	3.000 2.000						0. (0.)	0. (0.)	.0 .0	.0 .0	6.3 (13.8)	.01 (.50)	1	5	.0 (.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	BOOKS

TABLE 3-56

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 4.1.3 **** VISUAL RECREATION [SPACE STATION]

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	3.000						0.	120.	120.0	.0	22.7	.12	3	75	.0
	2.000						(0.)	(409.)	.0	.0	(50.0)	(4.27)			(.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	TELEVISION

TABLE 3-57

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 4.1.4 •••• GAMES [SPACE STATION]

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	.500 2.000						0. (0.)	0. (0.)	.0 .0	.0 .0	.4 (.8)	.00 (.07)	1	5	.0 (.0)
2	.500 2.000						0. (0.)	0. (0.)	.0 .0	.0 .0	.8 (1.8)	.03 (.04)	1	5	.0 (.0)
3	.500 2.000						0. (0.)	0. (0.)	.0 .0	.0 .0	5.4 (12.0)	.00 (.17)	1	5	.0 (.0)
4	.500 2.000						0. (0.)	0. (0.)	.0 .0	.0 .0	3.0 (6.7)	.00 (.17)	1	5	.0 (.0)
5	.500 2.000						0. (0.)	0. (0.)	.0 .0	.0 .0	3.0 (6.6)	.00 (.13)	1	5	.0 (.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	HANDBALL
2 -	DART BOARD/DARTS
3 -	BINOCULAR
4 -	CARDS
5 -	CALCULATOR

TABLE 3-58

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 4.2.1 **** EXERCISERS [SPACE STATION]

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	6.000 1.000						0. (0.)	0. (0.)	.0 .0	.0 .0	.9 (2.0)	.01 (.36)	1	5	.0 (.0)
2	6.000 .000						0. (0.)	0. (0.)	.0 .0	.0 .0	.2 (.5)	.00 (.04)	1	5	.0 (.0)

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	EXER-GYM
2 -	HAND EXERCISER

TABLE 3-59

APPLIANCE CONCEPT FUNCTION MATRIX

INDEX NO. 5.1.1 •••• AUTOCLAVES (SPACE STATION)

CONCEPT NO.	USAGE TIME	CONSUMABLES AND FLOW REQUIREMENTS					THERMAL REQMTS		ELEC PWR REQMTS		WT/VOL REQMTS		DEVELOPMENT COST		RESUPPLY
	USES/DAY HRS/USE	TYPE (*)	AMT. USED -KG/USE- (LB/USE)	FLOW * (*)	PRESS -MMHG- (PSIG)	TEMP -DEG C- (DEG F)	COOLANT -WATTS- (BTU/HR)	HT LEAK -WATTS- (BTU/HR)	PK PWR AC DC -WATTS-	AVG PWR AC DC -WATTS-	WEIGHT -KG- (LBS)	VOLUME -CU M- (CU FT)	AVAIL (**)	INDEX (***)	WEIGHT -KG- (LBS)
1	1.000	2	.0603	.00	.0	.0	0.	308.	1520.0	845.0	24.7	.16	1	25	.0
	.500		(.1330)	(.00)	(.0)	(.0)	(0.)	(1053.)	.0	.0	(54.4)	(5.58)			(.0)
		9	.0717	4.54	1551.4	21.1									
			(.1580)	(10.00)	(30.0)	(70.0)									
2	1.000						0.	421.	800.0	257.0	10.9	.14	1	25	.0
	2.330						(0.)	(1438.)	.0	.0	(24.0)	(4.78)			(.0)
3	1.000	2	.0603	.00	.0	.0	0.	112.	230.0	171.0	239.0	.26	2	45	216.0
	20.100		(.1330)	(.00)	(.0)	(.0)	(0.)	(381.)	.0	.0	(526.8)	(9.03)			(476.2)
		5	.0014	.00	.0	.0									
			(.0030)	(.00)	(.0)	(.0)									

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	MOIST HEAT
2 -	DRY HEAT
3 -	ETHYLENE OXIDE

(*)

1 - CABIN AIR	(CIRCULATED),	LITERS/SEC	(FT^3/MIN)
2 - CABIN AIR	(LOST) ,	KG/HR	(LB/HR)
3 - OXYGEN	(LOST) ,	KG/HR	(LB/HR)
4 - COOLING WATER	(CIRCULATED),	KG/HR	(LB/HR)
5 - WATER	(LOST) ,	KG/HR	(LB/HR)
6 - NITROGEN	(CIRCULATED),	KG/HR	(LB/HR)
7 - NITROGEN	(USED) ,	KG/HR	(LB/HR)
8 - FREON	(CIRCULATED),	KG/HR	(LB/HR)
9 - WATER	(PROCESSED) ,	KG/HR	(LB/HR)

(**)AVAILABLE	(***)COST INDICATOR
(1) AVAILABLE	0-25%
(2) STATE OF THE ART	25-50%
(3) SOME DEVELOPMENT REQUIRED	50-75%
(4) EXTENSIVE DEV. REQUIRED	75-100%

4.0 VEHICLE CREW APPLIANCE REQUIREMENTS

Shuttle and Space Station requirements for crew appliances are discussed in this section under Paragraphs 4.1 and 4.2, respectively. Requirements for each habitability subsystem are developed from the component habitability function requirements, and the resulting subsystems requirements are combined to form the basis of the total appliance system requirement of each spacecraft. Basic appliance system requirements defined are: heat rejection, electrical power, weight, and volume. The rationale behind each habitability function requirement, and the appliances which are included, are discussed.

4.1 SHUTTLE CREW APPLIANCE REQUIREMENTS

The Shuttle Orbiter vehicle requirements for crew appliances were determined exclusively from those described in Reference 276 unless otherwise noted. Most of the data documented in Reference 276 were developed for a baseline mission of 42 man-days (14 men and three days); therefore, alterations were made to the requirements data to make it representative of the 82 man-day mission assumed for this study.

The resulting Shuttle appliance system requirements are tabulated in Table 4-1. The total requirements listed at the bottom of the table represent the summation of all the subsystem requirements developed in the following paragraphs with the exception of heat rejection and electrical power. For these requirements, it was assumed that the heating and electrical loads for the housekeeping subsystem (electric vacuum cleaning)

TABLE 4-1

SHUTTLE APPLIANCE SYSTEM REQUIREMENTS

HABITABILITY SUBSYSTEM	HEAT REJECTION		ELECTRIC POWER			WEIGHT	VOLUME
	COOLANT	HT LEAK	PEAK	AVG	DEMAND		
	WATTS (Btu/hr)	WATTS (Btu/hr)	WATTS	WATTS	WATT-HR DAY	KG (lbs)	M^3 (ft^3)
FOOD MANAGEMENT (FROM TABLE 6-2)	8.4 (28.6)	721.9 (2463.9)	893.0	TBD	1201.0	38.4 (84.7)	0.170 (6.0)
PERSONAL HYGIENE (FROM TABLE 6-3)		165.0 (563.1)	805.0	TBD	636.6	588.4 (1297.2)	1.546 (54.6)
HOUSEKEEPING (FROM TABLE 6-4)		60.1 *(205.2)	*80.0	60.0	120.0	41.0 (90.4)	0.521 (18.4)
OFF DUTY (FROM TABLE 6-5)		165.4 (564.4)	250.0	TBD	740.0	85.5 (188.5)	0.283 (10.0)
* OMITTED FROM TOTAL							
SYSTEM TOTAL	8.4 (28.6)	1052.2 (3591.2)	1876.0		3175.0	753.0 (1660.0)	2.523 (89.1)

4.1 (Continued)

would not be imposed coincidentally with those of food management and personal hygiene.

4.1.1 Shuttle Food Management Subsystem Requirements

Food management subsystem habitability functions necessary for the Shuttle mission are:

- Food Storage
- Food Preparation
- Galley Cleanup

Requirements for heat rejection, electrical, weight, and volume for each of the functions are tabulated in Table 4-2 and their summations listed. Heat rejection and electrical requirements for food storage (refrigeration) and food preparation are summed directly since they must be operated coincidentally.

The food storage requirement is divided into ambient and refrigerated categories. Presently, there are no requirements for Shuttle frozen food storage. Since ambient food storage has no impact on the ECLSS or the management of spacecraft consumables, it is not considered in this system. Refrigeration requirements were derived from the basic packaged food requirements (perishable) determined from Skylab experience (Reference 250). Using these refrigerated food requirements, the refrigerator was sized using the methodology described in Reference 276.

TABLE 4-2
SHUTTLE FOOD MANAGEMENT SUBSYSTEM REQUIREMENTS

HABITABILITY FUNCTION	HEAT REJECTION		ELECTRIC POWER			WEIGHT	VOLUME
	COOLANT	HT LEAK	PEAK	AVG	DEMAND		
	WATTS (Btu/hr)	WATTS (Btu/hr)	WATTS	WATTS	WATT-HR DAY	KG (lbs)	M^3 (ft^3)
FOOD STORAGE	8.4 (28.6)	36.0 (122.9)	36.0	TBD	172.0	9.7 (21.4)	0.045 (1.6)
FOOD PREPARATION		685.9 (2341.0)	857.0	TBD	1029.0	24.6 (54.2)	0.110 (3.9)
GALLEY CLEANUP						4.1 (9.1)	0.014 (0.5)
SUBSYSTEM TOTAL	8.4 (28.6)	721.9 (2463.9)	893.0	TBD	1201.0	38.4 (84.7)	0.170 (6.0)

4.1.1 (Continued)

The amount of perishable food required to be refrigerated is 4.62 kg (10.4 lbs) with a volume .0116 m^3 (.41 ft^3) and must be maintained at a temperature between 1.67 and 4.44°C (35 and 40°F).

The food preparation function includes those appliances necessary for food rehydration and warming. There is no requirement for the cooking of food; and because food rehydration is a function with no conceptual options, this function was not investigated. Three types of food warming were described in Reference 276 (heating trays, convective oven, and microwave oven) with the requirements for a convective oven being designated as baseline.

The food cleanup requirements for Shuttle are minimal. Reusable utensils/dishes are assumed to be used with wet and dry wipes for cleaning them after each meal. The weight and volume of the utensils/dishes are included in this function since trades were made of disposable utensils/dishes against reusable utensils/dishes with various methods of cleanup (disposable wet/dry wipes, reusable wipes, dishwashers, etc.).

4.1.2 Shuttle Personal Hygiene Subsystem Requirements

Personal hygiene subsystem habitability functions necessary for the Shuttle mission are:

- Waste Collection/Transfer

4.1.2 (Continued)

- Body Cleansing
- Personal Grooming

Requirements for heat rejection, electrical, weight, and volume for this subsystem are listed in Table 4-3. Heat rejection and peak electrical power requirements for only the waste collection and transfer system were used in the total subsystem requirement as it was assumed the body cleansing unit would not be operated at the same time.

Waste collection/transfer requirements are equivalent to those of a commercial airliner for fecal/urine collection and vomitus collection. A dryjohn-type of system is used as a baseline requirement with the weight and volume of the wet/dry wipes being part of the requirement. The dryjohn system is self-contained with a replaceable collector being changed out after each mission. The requirement of no overboard venting necessitates the use of a vacuum generation and filter system to deactivate feces in the collector.

The body cleansing unit consists of a mechanical wetting and soaping unit with disposable wet/dry wipes. The system described in Reference 276 requires a water supply system, collector/dryer and storage for used wipes. The used wipes are vacuum dried with onboard evacuation system which exhausts to the cabin atmosphere, and these dried wipes are returned to earth. Water and wipe weight and volume are included in the requirement. There is no current Shuttle requirement for a whole body shower.

TABLE 4-3

SHUTTLE PERSONAL HYGIENE SUBSYSTEM REQUIREMENTS

HABITABILITY FUNCTION	HEAT REJECTION		ELECTRIC POWER			WEIGHT	VOLUME
	COOLANT	HT LEAK	PEAK	AVG	DEMAND		
	WATTS (Btu/hr)	WATTS (Btu/hr)	WATTS	WATTS	WATT-HR DAY	KG (lbs)	M^3 (ft^3)
WASTE COLLECTION/		165.0 (563.1)	805.0	165.0	430.9	316.0 (696.6)	0.728 (25.7)
BODY CLEANSING		99.9 *(341.3)	*500.0	100.0	205.7	265.2 (584.6)	0.793 (28.0)
PERSONAL GROOMING						7.3 (16.0)	0.0255 (0.9)
* OMITTED FROM TOTAL							
SUBSYSTEM TOTAL		165.0 (563.1)	805.0	165.0	636.6	588.4 (1297.2)	1.546 (54.6)

4.1.2 (Continued)

Personal grooming function consists of items necessary for shaving, dental hygiene, and other grooming aids. Mechanical hair or nail clippers are not considered because of shortness of the mission duration.

4.1.3 Shuttle Housekeeping Subsystem Requirements

Housekeeping subsystem habitability functions necessary for the Shuttle mission are:

- Equipment Cleaning
- Refuse Management
- Garment/Linen Maintenance

Requirements for heat rejection, electrical, weight, and volume for this subsystem are listed in Table 4-4. The only electrical and thermal requirement for this subsystem is the electrical vacuum cleaner used in refuse management.

The equipment cleaning requirements are for disposable wet/dry wipes which are used for washing, wiping, and sanitizing work surfaces.

Refuse management functions include refuse collection (manual and vacuum) and refuse disposal or storage. Collection containers are distributed in the galley, living areas, and personal hygiene facility; and these containers are periodically emptied into a central refuse storage area. A portable, self-contained vacuum cleaner with disposable collector bag is required. No trash compaction is required because of the mission duration.

TABLE 4-4
SHUTTLE HOUSEKEEPING SUBSYSTEM REQUIREMENTS

HABITABILITY FUNCTION	HEAT REJECTION		ELECTRIC POWER			WEIGHT	VOLUME
	COOLANT	HT LEAK	PEAK	AVG	DEMAND		
	WATTS (Btu/hr)	WATTS (Btu/hr)	WATTS	WATTS	WATT-HR DAY	KG (lbs)	M^3 (ft^3)
EQUIPMENT CLEANING						2.8 (6.1)	0.006 (.2)
REFUSE MANAGEMENT		60.1 (205.0)	80.0	60.0	120.0	20.6 (45.5)	0.408 (14.4)
GARMENT/LINEN						17.6 (38.8)	0.108 (3.8)
SUBSYSTEM TOTAL		60.1 (205.0)	80.0	60.0	120.0	41.0 (90.4)	0.521 (18.4)

4.1.3 (Continued)

Garment/linen maintenance requirements are met by the use of disposable items rather than the use of any washing and drying devices because of the short mission duration. Thus, this function has only a weight and volume consideration with no impact to the ECLSS.

4.1.4 Shuttle Off-Duty Subsystem Requirements

The off-duty subsystem habitability functions necessary for the Shuttle mission are:

- Entertainment
- Physical Conditioning

Requirements for heat rejection, electrical, weight, and volume for this subsystem are listed in Table 4-5.

Entertainment requirements are audio system, audio-visual system, books, and other entertainment devices such as darts, games, cards, etc. Audio and audio-visual systems are electrical devices which produce a thermal load to the ECLSS. Physical conditioning equipment includes spring- or bungee-type exercise devices.

4.2 SPACE STATION CREW APPLIANCE REQUIREMENTS

The Space Station vehicle appliance requirements listed in this section were determined from those described in Reference 29 unless otherwise noted. Most of the data documented in this reference were developed for

TABLE 4-5

SHUTTLE OFF-DUTY SUBSYSTEM REQUIREMENTS

HABITABILITY FUNCTION	HEAT REJECTION		ELECTRIC POWER			WEIGHT	VOLUME
	COOLANT	HT LEAK	PEAK	AVG	DEMAND		
	WATTS (Btu/hr)	WATTS (Btu/hr)	WATTS	WATTS	WATT-HR DAY	KG (lbs)	M^3 (ft^3)
ENTERTAINMENT		165.4 (564.4)	270.0	179.9	740.0	85.5 (188.5)	0.283 (10.0)
PHYSICAL CONDITIONING						INCLUDED ABOVE	
SUBSYSTEM TOTAL		165.4 (564.4)	270.0	179.9	740.0	85.5 (188.5)	0.283 (10.0)

4.2 (Continued)

a baseline mission of 180 man-days (six men and 30 days); therefore, alterations were made to the data to make it representative of the 1104 man-day mission assumed for this study.

Resulting Space Station appliance system requirements are tabulated in Table 4-6. Total requirements listed at the bottom of the table represent the summation of all the subsystem requirements developed in the following paragraphs. The same format used to describe the Shuttle requirements (Paragraph 6.1) with appliances grouped into subsystems is used in this section.

4.2.1 Space Station Food Management Subsystem Requirements

The food management subsystem habitability functions necessary for Space Station mission are:

- Food Storage
- Food Preparation
- Galley Cleanup

A summary of the heat rejection, electrical power, weight, and volume requirements is tabulated in Table 4-7. The requirements are summed directly except for the inclusion of the food preparation electrical and heat rejection requirements. It was assumed that the dishwasher (galley cleanup) and oven (food preparation) would not be operating at the same time; thus, the lower (oven) requirements were omitted to determine the maximums.

TABLE 4-6

SPACE STATION APPLIANCE SYSTEM REQUIREMENTS

HABITABILITY SUBSYSTEM	HEAT REJECTION		ELECTRIC POWER			WEIGHT	VOLUME
	COOLANT	HT LEAK	PEAK	AVG	DEMAND		
	WATTS (Btu/hr)	WATTS (Btu/hr)	WATTS	WATTS	WATT-HR DAY	KG (lbs)	M^3 (ft^3)
FOOD MANAGEMENT (FROM TABLE 4-7)		958.0 (3269.7)	TBD	958.0	TBD	532.2 (1173.3)	6.313 (222.9)
PERSONAL HYGIENE (FROM TABLE 4-8)		299.0 (1020.4)	TBD	299.0	TBD	287.3 (633.3)	2.852 (100.7)
HOUSEKEEPING (FROM TABLE 4-9)		14.0	TBD	14.0	TBD	267.5 (589.8)	2.580 (91.1)
OFF-DUTY (FROM TABLE 4-10)		TBD	TBD	TBD	TBD	170.1 (375.0)	3.398 (120.0)
SYSTEM TOTAL		TBD	TBD	TBD	TBD	1257.1 (2771.4)	15.142 (534.7)

TABLE 4-7

SPACE STATION FOOD MANAGEMENT SUBSYSTEM REQUIREMENTS

HABITABILITY FUNCTION	HEAT REJECTION		ELECTRIC POWER			WEIGHT	VOLUME
	COOLANT	HT LEAK	PEAK	AVG	DEMAND		
	WATTS (Btu/hr)	WATTS (Btu/hr)	WATTS	WATTS	WATT-HR DAY	KG (lbs)	M^3 (ft^3)
FOOD STORAGE		858.0 (2928.4)	TBD	858.0	TBD	486.8 (1073.3)	4.860 (171.6)
FOOD PREPARATION		80.0 *(273.0)	*160.0	*80.0	TBD	19.1 (42.0)	0.037 (1.3)
GALLEY CLEANUP		100.0 (341.3)	TBD	100.0	260.0	26.3 (58.0)	1.416 (50.0)
* OMITTED FROM TOTAL							
SUBSYSTEM TOTAL		958.0 (3269.7)	TBD	958.0	TBD	532.2 (1173.3)	6.313 (222.9)

4.2.1 (Continued)

Food storage requirements are divided into ambient, refrigerated, and frozen categories. Ambient food storage has no impact on the ECLSS or the consumable management problem; therefore, ambient food storage was not included in this system. The refrigerator serves as a storage compartment for use in defrosting foods, storing unprepared foods, and a maximum of a 6-week supply of perishable foods. The refrigerator will maintain stored food at temperatures ranging from 4.4 to 10^{0}C (40 to 50^{0}F) with an interior volume of approximately 1.7 m^2 (60 ft^3).

Also in the food storage function is a freezer requirement capable of storing .59 m^3 (21 ft^3) of food at temperature ranging from (-10 to +5^{0}F). The concept described in Reference 29 is a vapor cycle-type of cooling unit.

The food preparation function includes those necessary for food rehydration and warming. A combination resistance and microwave oven is provided for the cooking or heating of fresh and dehydrofrozen and reconstituted foods. The oven can accommodate a six-man meal and is capable of heating food items from the frozen state to 71.1^{0}C (160^{0}F) in 10 to 15 minutes.

Galley cleanup appliances include a dishwasher/dryer for automatic washing and drying of food preparation, serving, and eating devices. The system provides an integral water heater capable of heating and holding water at a temperature of 76.7^{0}C (170^{0}F) to clean and sterilize utensils for one six-man crew. Requirements for serving and eating trays, eating utensils,

4.2.1 (Continued)

and other galley food preparation items are included in the galley cleanup function.

4.2.2 Space Station Personal Hygiene Subsystem Requirements

Personal hygiene subsystem habitability functions necessary for the Space Station mission are:

- Waste Collection/Transfer
- Body Cleansing
- Personal Grooming

Requirements for heat rejection, electrical power, weight, and volume are tabulated and totaled in Table 4-8.

Waste collection/transfer requirements are equivalent to those of a commercial airliner for fecal and urine collection and appropriate expendables. The system is provided with a self-contained odor, liquids, and contaminant control. A second urinal is provided outside the waste management system compartment and shares "console" space with the partial body wash device.

The body cleansing function includes a whole body shower and a partial body washing device or sink (see above). A shower consists of a cylindrical enclosure equipped with provisions for wetting, washing, rinsing and drying the body. This system is designed to impinge a mixture of

TABLE 4-8

SPACE STATION PERSONAL HYGIENE SUBSYSTEM REQUIREMENTS

HABITABILITY FUNCTION	HEAT REJECTION		ELECTRIC POWER			WEIGHT	VOLUME
	COOLANT	HT LEAK	PEAK	AVG	DEMAND		
	WATTS (Btu/hr)	WATTS (Btu/hr)	WATTS	WATTS	WATT-HR DAY	KG (lbs)	M^3 (ft^3)
WASTE COLLECTION/TRANSFER		79.0 (269.6)	TBD	79.0	TBD	230.8 (508.8)	1.136 (40.1)
BODY CLEANSING		200.0 (682.6)	TBD	200.0	TBD	45.4 (100.0)	1.700 (60.0)
PERSONAL GROOMING		20.0 (68.2)	20.0	20.0	TBD	11.1 (24.5)	0.017 (.6)
SUBSYSTEM TOTAL		299.0 (1020.4)	TBD	299.0	TBD	287.3 (633.3)	2.852 (100.7)

4.2.2 (Continued)

warm air and water upon the body from a fixed or hand-held shower head. A blower and water collector are used to remove the local accumulation of water. Towels are required to complete body drying. The sink provides hand and face wash capability with ambient and hot water mix along with metered dispensing of a cleaning agent.

The personal grooming function includes a kit for each crewman containing such items as electric razor, comb, hair brush, nail clipper, toothbrush, dentifrice, deodorant, and after shave lotion.

4.2.3 Space Station Housekeeping Subsystem Requirements

The housekeeping subsystem habitability requirements are:

- Equipment Cleaning
- Refuse Management
- Garment/Linen Maintenance

The heat rejection, electrical power, weight, and volume requirements for the components of this subsystem are tabulated in Table 4-9.

The equipment cleaning function includes those items necessary for cleaning and disinfection of all microbiological contamination of equipment and surfaces exposed to the crew.

TABLE 4-9

SPACE STATION HOUSEKEEPING SUBSYSTEM REQUIREMENTS

HABITABILITY FUNCTION	HEAT REJECTION		ELECTRIC POWER			WEIGHT	VOLUME
	COOLANT	HT LEAK	PEAK	AVG	DEMAND		
	WATTS (Btu/hr)	WATTS (Btu/hr)	WATTS	WATTS	WATT-HR DAY	KG (lbs)	M^3 (ft^3)
EQUIPMENT CLEANING						83.5 (184.0)	0.867 (30.6)
REFUSE MANAGEMENT		4.0 (13.6)	TBD	4.0	TBD	117.1 (258.1)	1.147 (40.5)
GARMENT/LINEN MAINTENANCE		10.0 (34.1)	250.0	10.0	TBD	45.4 (100.0)	0.566 (20.0)
SUBSYSTEM TOTAL		14.0 (47.7)	250.0	14.0	TBD	267.5 (589.8)	2.580 (91.1)

4.2.3 (Continued)

Refuse management appliances provide for collection, containment, decontamination, and transport of all forms of loose debris, trash, and particulate material generated by the crew and equipment throughout the station. A trash compactor is provided to reduce the volume of collected trash. Sufficient containers are provided to handle approximately 3.4 m^3 (120 ft^3) of uncompacted trash every 30 days.

Garment/linen maintenance requirements are provided by a washing machine utilizing mechanical agitation and semidrying through centrifugal force. Once washed and semidried, the clothing and linen are dried further by vacuum evaporation prior to storage or use. The laundry is capable of handling a minimum of 4.54 kg (10 lbs) of dry articles per cycle.

4.2.4 Space Station Off-Duty Subsystem Requirements

Space Station off-duty habitability functions are:

- Entertainment
- Physical Conditioning

Requirements for heat transfer, electrical power, weight, and volume for this subsystem are tabulated in Table 4-10. This subsystem includes television receivers and stereo equipment as well as other equipment for reading, games, and exercising. The requirements were not broken down by categories in the Reference 29 study; only the composite value shown in Table 4-10 was listed.

TABLE 4-10

SPACE STATION OFF-DUTY SUBSYSTEM REQUIREMENTS

HABITABILITY FUNCTION	HEAT REJECTION		ELECTRIC POWER			WEIGHT	VOLUME
	COOLANT	HT LEAK	PEAK	AVG	DEMAND		
	WATTS (Btu/hr)	WATTS (Btu/hr)	WATTS	WATTS	WATT-HR DAY	KG (lbs)	M^3 (ft^3)
ENTERTAINMENT							
PHYSICAL CONDITIONING							
NO BREAKDOWN							
SUBSYSTEM TOTAL		TBD	TBD	TBD	TBD	170.1 (375.0)	3.398 (120.0)

5.0 WEIGHTED TRADE STUDY

Optimum appliance concepts were selected from the Appliance Concept Function Matrices described in Paragraph 4.0 using the results of a weighted trade-off study. In addition to the operational parameters summarized in the Appliance Concept Function Matrix, the appliance concept reliability, maintainability, and safety were also included as evaluation criteria for selecting the optimum concept. Crew preference, convenience, and usage time were not factored into the trade study so that the optimum choice could be based only on "hard" data. Crew considerations are taken into account during the final appliance subsystem and system optimization study, Paragraph 6.0. The above-mentioned selection parameters were each apportioned points to make up a weighting distribution. Once the weighting distribution was established, the appliance concept selection then depended on the rationale used to ratio each parameter to its point allotment. A computer program was developed utilizing the weighting distribution and the appliance concept selection rationale to automatically perform the weighted trades and determine the relative ratings of the appliance concepts.

5.1 WEIGHTING DISTRIBUTION RATIONALE

Selection of the optimum appliance concept utilizing a weighting technique requires that the trade parameter weighting distribution be consistent with vehicle requirements and program goals. Numerous references were consulted to develop the weighting distribution technique, and finally an analytical comparison was made to a previous study (Reference 237) to provide a proper weighting distribution. The study, Reference 237, provided

5.1 (Continued)

an in-depth trade study of various clothes washer concepts. Study results selected, as the optimum concept, a water spray agitated clothes washer for a Space Station having a resupply period of 230 days. The appliance concept selection program was adjusted to use a 230-day resupply period. Selection program runs were made for disposable clothes and eight clothes washer concepts using four different weighting distributions. The results of these runs were plotted (see Figure 5-1) to determine which distribution would select water spray agitation as the optimum concept. An even weighting distribution (all parameters having the same point value) was used as the basis for comparison of the remaining three weighting distributions (upper portion of Figure 5-1). Point distributions were varied to accentuate the more important parameters--cost, weight, volume, and thermal requirements. The fourth weighting distribution gave the water spray agitation washer the top rating; however, the third weighting distribution was chosen for conducting trade studies because of the heavier emphasis on cost. Present space program economic considerations were judged to be more critical than when the Reference 237 study was conducted.

On the basis of these data, the following weighting distribution was used for selecting the optimum appliance concepts.

- Development Cost Weighting Factor - 15 Pts.
  - Cost was considered to be of prime importance.
- Weight Weighting Factor - 15 Pts.
  - The effect of weight was rated equally important as cost,

WEIGHTING VALUES USED
FOR WEIGHTING FUNCTIONS

	1 ⊡	2 ◈	3 ⊡	4 ⊙
COST	10	20	15	10
RELIABILITY	10	5	5	5
MAINTENANCE	10	5	5	5
SAFETY	10	5	5	5
WEIGHT	10	15	15	15
POWER	10	15	15	15
VOLUME	10	10	10	10
THERMAL	10	15	15	15

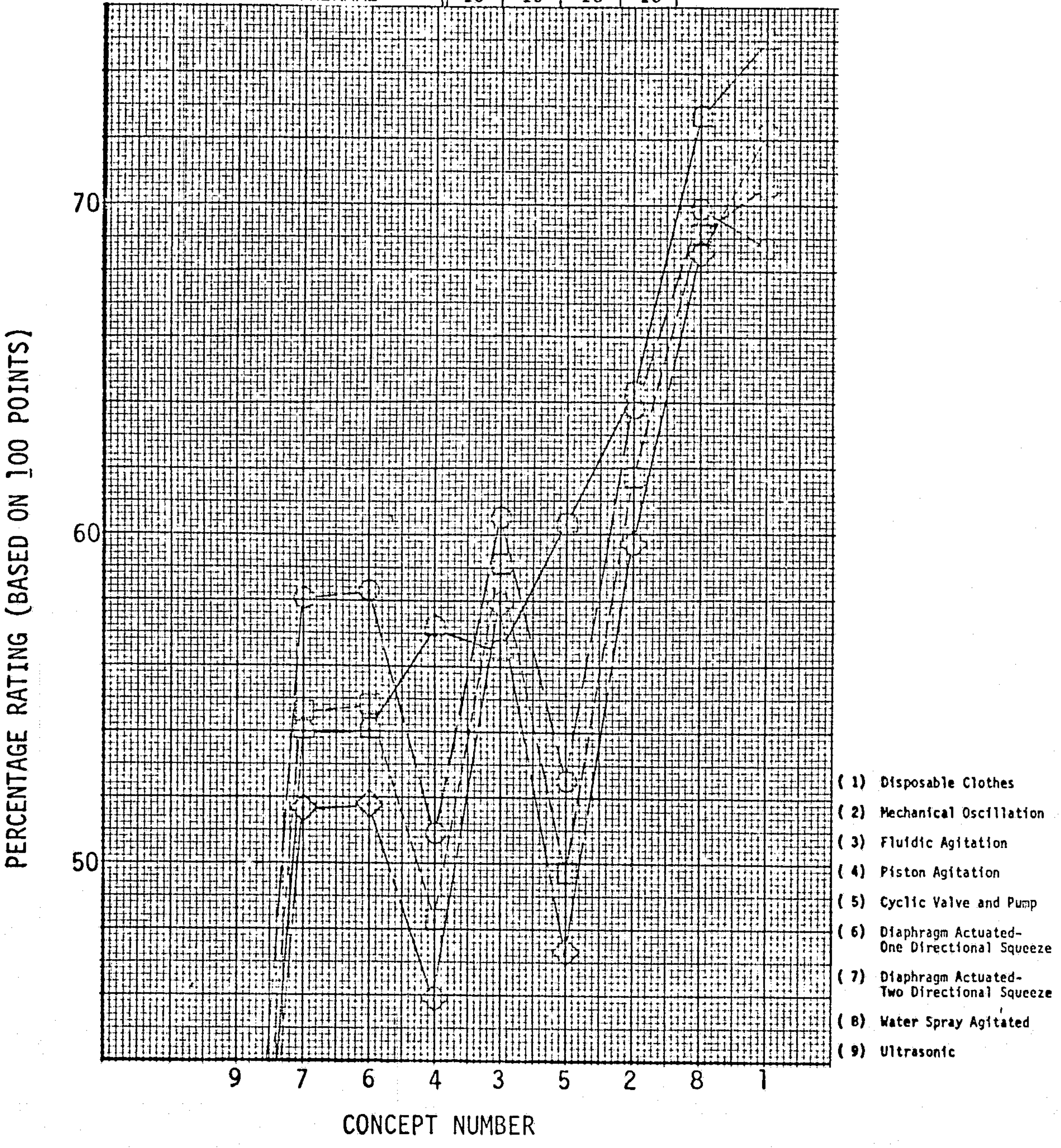


FIGURE 5-1 CLOTHES WASHERS TRADE STUDY

5.1 (Continued)

since launch weight (and/or resupply weight) of the vehicles is considered to govern over vehicle volume.

- Volume Weighting Factor - 10 Pts.
  - The vehicles are not considered volume critical; therefore, volume was rated lower than weight.
- Power Weighting Factor - 15 Pts.
  Thermal Weighting Factor - 15 Pts.
  - Power and thermal were rated the same as weight because each is represented in terms of equivalent vehicle weight. In addition, the appliance concept efficiency is indicated by the power and thermal values.
- Reliability Weighting Factor - 5 Pts.
  Maintainability Weighting Factor - 5 Pts.
  Safety Weighting Factor - 5 Pts.
  - The reliability, maintainability, and safety calculations for the various appliance concepts were estimated based on appliances which are not thoroughly defined. The degree of technical definition of each appliance concept affects the accuracy of the reliability, maintainability, and safety analysis. The method used to calculate reliability, maintainability, and safety is sufficiently detailed for concept selection, but was not weighted as heavily as all other weighting factors. More development, for instance, could readily turn a concept poor in reliability, maintainability, or safety into one exhibiting excellent characteristics in these areas. Reliability, maintainability, and safety were, therefore, rated lowest in order

5.1 (Continued)

not to unduly penalize a promising concept still under development.

- Recurring Cost Weighting Factor - 15 Pts.
  - The recurring cost was included to penalize appliance concepts requiring resupply for the Modular Space Station.

5.2 APPLIANCE CONCEPT SELECTION RATIONALE

The appliance concept selection parameters used for conducting appliance trade studies were development cost, reliability, safety, maintenance, weight, electrical power, thermal, and volume. Recurring cost was included for the Space Station to weigh resupply requirements. The rationale used to apply each of these parameters in the trade study is described in the following paragraphs.

5.2.1 Development Cost

Development cost data for each concept could not be accurately computed since many concepts were not defined well enough to estimate cost accurately for comparison with well-defined concepts. Rockwell International (References 258 and 259) and Mc Donnell Douglas (Reference 257) Modular Space Station studies were consulted for cost data; however, these references did not break down cost data to a level useful for estimating appliance concepts costs. The technique used in Reference 258 to factor subsystem costs is similar to the system used for this study.

5.2.1 (Continued)

Since cost is related to availability and complexity, each concept was rated using these parameters. The availability categories are (1) available (ready for vehicle), (2) state of the art (prototype), (3) some development required (breadboard), and (4) extensive development required (conceptual). The availability was determined for each appliance concept and then each concept was rated in its category by complexity to derive the cost indicator. The cost indicator ranges are as follows:

Availability	Cost Indicator
(1) Available	0-25%
(2) State of the art	25-50%
(3) Some development required	50-75%
(4) Extensive development required	75-100%

For example, disposable clothes would be ranked with an availability of 1 and because of its simplicity, would be rated with a cost indicator or 0%. The cost indicator is rated on a scale of zero (0) to 15 points with zero (0) percent being assigned 15 points and the maximum value assigned zero (0) points.

5.2.2 Reliability, Maintenance, and Safety

Data used to determine each appliance concept reliability, maintenance, and safety ratings are summarized in Appendices B and C. A numerical tabulation of the major mechanical and electrical components making up each

5.2.2 (Continued)

appliance concept was used in evaluating the ratings of these three factors. Figure 5-2 shows an example of the refrigerator appliance function. In this example, the appliance function contains three appliance concepts with the number and type of components making up each of the concepts summarized. Component type numbers (circled) correlate with the component number in Figure 5-3 for convenience of input into the computer trade program. Figure 5-3 presents the failure rate and repair times assigned to each of the components contained in all of the Appliance Concept Component Summary Matrices presented in Appendices B and C. Failure rate and repair times were based on data from the indicated references. Repair times for components not having a reference number denoted were estimated from Space Station Prototype background.

Appliance concept components considered to be safety critical items are summarized at the right-hand side of Figure 5-2. Safety critical components were those components which during the appliance concept evaluation were judged to possibly result in death or injury to the crew and/or in a mission abort.

The rationale used to apply the data presented in Figures 5-2 and 5-3 to the trade program are contained in Paragraphs 5.2.2.1, 5.2.2.2, and 5.2.2.3.

5.2.2.1 Reliability

The reliability of each appliance concept was evaluated using standard reliability equations. Assumptions made were (1) a constant failure rate

APPLIANCE FUNCTION: 1.1.2-REFRIGERATORS

COMPONENT TYPE	NUMBER OF COMPONENTS																NUMBER OF SAFETY CRITICAL ITEMS
	MOTOR	PUMP	SOLENOID VALVE	HEAT EXCHANGER	CONTROLLER	BLOWER											
APPLIANCE TYPE NO.	①	②	③	⑯	⑬	⑱	○	○	○	○	○	○	○	○	○	○	
SPACE RADIATOR	1	1	2	2	1	-											0
THERMOELECTRIC	2	-	-	-	1	2											1
AIR CYCLE TURBINE/COMPRESSOR	2	2	-	1	1	1											0

Figure 5-2. Appliance Concept Component Summary Matrix Example

COMPONENT NUMBER	COMPONENT DESCRIPTION	REFERENCE NUMBER	FAILURE RATE ($\lambda x10^{-6}$) FAILURES/ MILLION HOURS	REFERENCE NUMBER	REPAIR TIMES (MTTR) HRS/REPAIR
1	MOTOR	252	3.8	-	0.5+.2=.7
2	PUMP	100	6.0	254	0.2+.25=.45
3	SOLENOID VALVE	100	0.72	254	0.1+.2=.3
4	ACCUMULATOR	100	0.01	-	0.5+.2=.7
5	ACCUMULATOR/ BLADDER	251	1.77	-	0.5+.4=.9
6	WATER SEPARATOR	100	1.20	254	0.2+.2=.4
7	TRANSMISSION	251	1.50	-	0.5+.1=.6
8	FLUIDIC SWITCH	251	1.61	-	1.0+.1=1.1
9	FILTER	251	0.16	-	0.1+.2=.3
10	ELECTRIC SWITCH	252	5.74	-	0.2+.1=.3
11	PRESSURE REGULATOR	100	2.94	254	0.1+.1=.2
12	VALVE (GN_2)	100	0.72	254	0.1+.2=.3
13	CONTROLLER	251	2.5	254	0.1+.3=.4
14	HIGH FREQUENCY CONTROLLER	-	UNK	-	UNK
15	ELECTROACOUSTIC TRANSDUCER	252	86.2	254	0.1+.2=.3
16	HEAT EXCHANGER	251	0.23	254	0.2+.5=.7
17	HEATER-DC	251	1.0	-	0.2+.1=.3
18	BLOWER-AIR	251	10.89	254	0.2+.1=.3
19	CONTROLLER/ TIMER	251	2.5	254	0.1+.3=.4
20	THERMAL STORAGE UNIT (WAX)	251	0.23	-	0.2+.5=.7
21	DESICCANT CANISTER	251	0.21	-	0.2+.5=.7
22	CHECK VALVE	251	0.312	-	0.1+.2=.3
23	MANUAL VALVE	251	0.776	-	0.1+.2=.3
24	TEMPERATURE CONTROL VALVE	251	7.183	-	0.1+.2=.3
25	RELIEF VALVE	251	0.312	-	0.1+.2=.3
26	RF GENERATOR (MAGNETON TUBE)		UNK		UNK
27	ACTUATOR	252	.024		0.2+.5=.7
28	PRESSURE SWITCH	251	3.57	-	0.1+.2=.3

Figure 5-3. Component Failure Rate and Repair Times

5.2.2.1 (Continued)

and (2) no spare provisioning to improve the concepts reliability rating. The method used to calculate reliability is summarized below.

a. Determine number of each component, n, from Figure 5-2.

b. Determine λ (failures per hour) from Figure 5-3 for each component.

c. Determine operating time, T, from Appliance Concept Function Matrix.

d. Calculate for each component the product of $n_i \lambda_i T$.

e. Sum the individual component $n\lambda T$ for each concept.

$$\sum_{i=1}^{N} n_i \lambda_i T$$

where N is the number of unique components in a concept.

f. Calculate the reliability of each concept

$$R = e^{-\sum_{i=1}^{N} n_i \lambda_i T}$$

g. Determine the unreliability for weighting purposes

$$R_u = 1 - R$$

The unreliability, R_u, is rated on a scale of zero (0) to 5 points with zero (0) unreliability being assigned 5 points and the maximum value assigned zero (0) points.

5.2.2.2 Maintenance

Maintainability of each appliance concept was evaluated using standard maintainability equations. Repair rates were estimated using Reference as a guide for removal and replacement times. The repair times have not been evaluated in a zero-g environment; however, they do represent replacement times for actual Space Station Prototype hardware. The method used to calculate maintainability is summarized below:

a. Determine the hours of repair (hrs/repair), M_{CT} or MTTR, from Figure 5-3 for each component.

b. Multiply the failure rate, λ, by the number of each component, n, from Figure 5-2.

$$n \lambda$$

c. Multiply the $n \lambda$ by the M_{CT}.

$$n \lambda M_{CT}$$

d. Sum items b and c for all components included in a concept

$$\sum_{i=1}^{N} n_i \lambda_i$$

$$\sum_{i=1}^{N} n_i \lambda_i M_{CT_i}$$

5.2.2.2 (Continued)

e. Calculate the concept mean time to repair, MTTR, total:

$$MTTR = \frac{\sum_{i=1}^{N} n_i \lambda_i M_{CT_i}}{\sum_{i=1}^{N} n_i \lambda_i} \text{, HRS}$$

f. Calculate the concept availability, A:

$$A = \frac{MTBF}{MTBF + MTTR}$$

where mean time between failures, MTBF:

$$MTBF = \frac{1}{\sum_{i=1}^{N} n_i \lambda_i} \text{, HRS}$$

g. Calculate the unavailability, A_u, for weighting purposes.

$$A_u = 1 - A$$

The unavailability, A_u, is rated on a scale of zero (0) to 5 points with zero (0) unavailability being assigned 5 points and the maximum value assigned zero (0) points.

5.2.2.3 Safety

The appliance concepts were individually evaluated to determine the number of safety critical components contained within each design. A total count of the safety critical components were then summarized for each concept (see example in Figure 5-2). Safety is rated on a scale of zero (0) to 5 points with zero (0) safety criteria items being assigned 5 points and the maximum value assigned zero (0) points.

5.2.3 Weight

The weight for each appliance concept was derived from the literature and is tabulated in the Modular Space Station and Shuttle Orbiter Appliance Concept Function Matrix. The weight data, used directly from appliance functions matrix, were rated on a scale of zero (0) to 15 points with zero (0) kg (lbs) being assigned 15 points and the maximum value assigned zero (0) points.

5.2.4 Power and Thermal

Power and thermal parameters for each appliance concept were derived from the literature and are tabulated in the Modular Space Station and Shuttle Orbiter Appliance Concept Function Matrix. The parameters are converted by the trade program to equivalent vehicle weight and are rated on a scale of zero (0) to 15 points with zero (0) kg (lbs) being assigned 15 points and the maximum value assigned zero (0) points.

5.2.4.1 Power

Power parameters were converted to equivalent vehicle weight by assessing a penalty based on the type of power generation device required (AC or DC). Penalty factors were taken from Reference 273. The resulting Modular Space Station penalties based on a solar cell/battery DC power system using inverters to satisfy AC power requirements are: .322 kgm/watt (.71 lbs/watt) (AC) and .268 kgm/watt (.591 lbs/watt)(DC). Shuttle power equivalent vehicle weight factors derived from the current Shuttle power system using fuel cell generated DC power and inverters for AC power are: .24 kgm/watt (.53 lbs/watt)(DC) and .195 kgm/watt (.43 lbs/watt)(AC).

5.2.4.2 Thermal

The thermal equivalent vehicle weight penalty was determined based on the type of heat rejection employed by the appliance concept. Space Station thermal factors used to convert to equivalent vehicle weight were: .084 kgm/watt (.0540 lbs/Btu/hr)(direct to coolant); and .190 kgm/watt (.1280 lbs/Btu/hr)(cabin heat leak). The factors were taken from Reference 173. The Shuttle Orbiter factors were: .039 kgm/watt (.025 lbs/Btu/hr)(direct to coolant); and .085 kgm/watt (.0550 lbs/Btu/hr)(cabin heat leak). The direct to coolant thermal equivalent vehicle weight factor .039 kgm/watt (.025 lbs/Btu/hr) was provided by the Shuttle heat rejection radiation system developer. Cabin heat leak equivalent vehicle weight factor assigned was the value used by Rockwell International Corporation during their Shuttle Orbiter study phase, .085 kgm/watt (.0550 lbs/Btu/hr). It should be noted that the study assumed that both latent and sensible heat rejected directly to the cabin

5.2.4.2 (Continued)

were lumped as cabin heat leak. The heat rejected directly at an appliance/ ECLSS coolant interface was considered as heat rejected to coolant.

5.2.5 Volume

The volume for each appliance concept is derived from the literature and has been tabulated in the Modular Space Station/Space Shuttle Orbiter Appliance Concept Function Matrix. The volume is rated on a scale of zero (0) to 10 points with zero (0) cubic meters (cubic feet) being assigned 10 points and the maximum value assigned zero (0) points.

5.2.6 Recurring Cost

Recurring cost is equated to the expendable weight requirements tabulated in the Appliance Concept Function Matrix for each appliance concept. The weight is rated on a scale of zero (0) to 15 points with zero (0) kg (lbs) being assigned 15 points and the maximum value assigned zero (0) points.

5.3 APPLIANCE CONCEPT TRADE PROGRAM DESCRIPTION

Using the above appliance weighting concept selection and rationale, a computer trade program was developed to handle the large number of appliance concepts and selection parameters. A program listing of the trade program and a brief description will be included in the final report. Data contained in the Appliance Concept Function Matrix were used as input to the program. The trade program, based on the input data, converts the thermal

5.3 (Continued)

and electrical power requirements to equivalent vehicle weights and computes the appliance ratings based on their standing within the minimum to maximum selection parameter values.

The program prints out a selection matrix having the minimum and maximum value, the maximum rating value, and the final weighted value for each selection factor (parameter), see Figure 5-4. The rating is then ratioed up to 100 points for convenience of comparison. A sensitivity analysis is computed for each appliance function which varies each selection factor plus and minus 50 percent while holding the remaining selection factors constant. Final ratings based on 100 points can be compared to the normal trade results. The purpose of the sensitivity analysis is to show which selection factors are most critical to the selection of an appliance concept and how competitive the remaining appliance concepts are to the selected concept. The tabulated selection matrix and the sensitivity analysis for each appliance function are contained in Appendices B and C.

The trade program has the capability to vary mission durations, resupply periods, and weighting factor sensitivity. The present program uses a 20.5-day mission for Shuttle Orbiter and 184-day and 5-year missions with a resupply period of 180 days for Space Station. The 5-year mission case was investigated to evaluate the feasibility of more complex appliances for extended mission durations. A resupply time of 180 days was chosen based on near-term state-of-the-art technology. Longer resupply periods will be adopted as the Modular Space Station matures.

TABULATED SELECTION MATRIX (TRADE RESULTS)

```
NUMBER OF DAYS =   20.5 ( .06 YEARS)
USES MOD SUBROUTINE  0
THERMAL PENALTY - DIRECT TO COOLANT (LB/BTUH)  .0250
THERMAL PENALTY - CABIN HEAT LEAK   (LB/BTUH)  .0550
POWER PENALTY (LBS/WATT) TYPE 1    .5300
POWER PENALTY (LBS/WATT) TYPE 2    .4300


         SELECTION MATRIX  .  .  .  .  .  REFRIGERATED FOOD STORAGE (SHUTTLE)
                                (12/15/74)


              MIN          MAX                                   C O N C E P T
FACTOR       VALUE        VALUE      PTS     1       2        3

WEIGHT      3.1000       160.00       15   13.16   14.71     .00
POWER       26.500       5406.0       15   14.93   14.88     .00
VOLUME      1.4400       42.000       10    9.66    9.19     .00
THERMAL     8.4650       230.95       15   14.45   14.45     .00
RELIAB-Y    .98379       .99304        5    2.85     .20     .00
MAINTENC    .99998       .99999        5    2.65     .76     .00
SAFETY      .00000       1.0000        5    5.00     .00    5.00
DEV COST    .00000       70.000       15   15.00    9.64     .00
TOTAL PT    .00000       85.000       85   77.70   63.83    5.00

RATING      .00000       100.00      100   91.41   75.10    5.88
```

SENSITIVITY ANALYSIS RESULTS

```
                RATING FOR EACH CONCEPT AFTER INCREASING
        SINGLE SELECTION PARAMETER WEIGHTING FACTOR BY -50 %
                     (BASED ON 100 % MAX POINTS)

                                       C O N C E P T
                1        2        3

 NORMAL       91.41    75.10     5.88

 WEIGHT       91.76    72.87     6.45
 POWER        90.63    72.76     6.45
 VOLUME       91.09    74.04     6.25
 THERMAL      90.93    73.04     6.45
 RELIAB-Y     92.45    77.25     6.06
 MAINTENC     92.57    76.91     6.06
 SAFETY       91.15    77.37     3.03
 DEV COST     90.58    76.14     6.45
                RATING FOR EACH CONCEPT AFTER INCREASING
        SINGLE SELECTION PARAMETER WEIGHTING FACTOR BY  50 %
                     (BASED ON 100 % MAX POINTS)

                                       C O N C E P T
                1        2        3

 NORMAL       91.41    75.10     5.88

 WEIGHT       91.11    76.96     5.41
 POWER        92.07    77.05     5.41
 VOLUME       91.70    76.03     5.56
 THERMAL      91.81    76.82     5.41
 RELIAB-Y     90.43    73.06     5.71
 MAINTENC     90.31    73.38     5.71
 SAFETY       91.66    72.95     8.57
 DEV COST     92.11    74.22     5.41
```

Figure 5-4. Example of Tabulated Trade Results and Sensitivity Analysis

5.3 (Continued)

Results of the weighted trade program study are summarized in Figures 5-5 through 5-53. The concept having the highest rating (0-100 percent) is the optimum appliance concept selected by the trade program for the given appliance function. The off-duty activity habitability system was not considered by the trade program because of the limited number and simplicity of the appliance concepts. Also, food hydration and ergometer appliance functions were not traded since their concept choices were straightforward. Refuse transfer was not traded, since the study assumed only manual refuse transfer.

The optimized spacecraft appliance systems derived in Paragraph 6.0 are composed of those appliances which rate highest in the trade program or those appliances which provide the greatest crew convenience and minimum impact on the ECLSS.

APPLIANCE
CONCEPT
NO. CONCEPT NAME

1 = RIGID
2 = FLEXIBLE

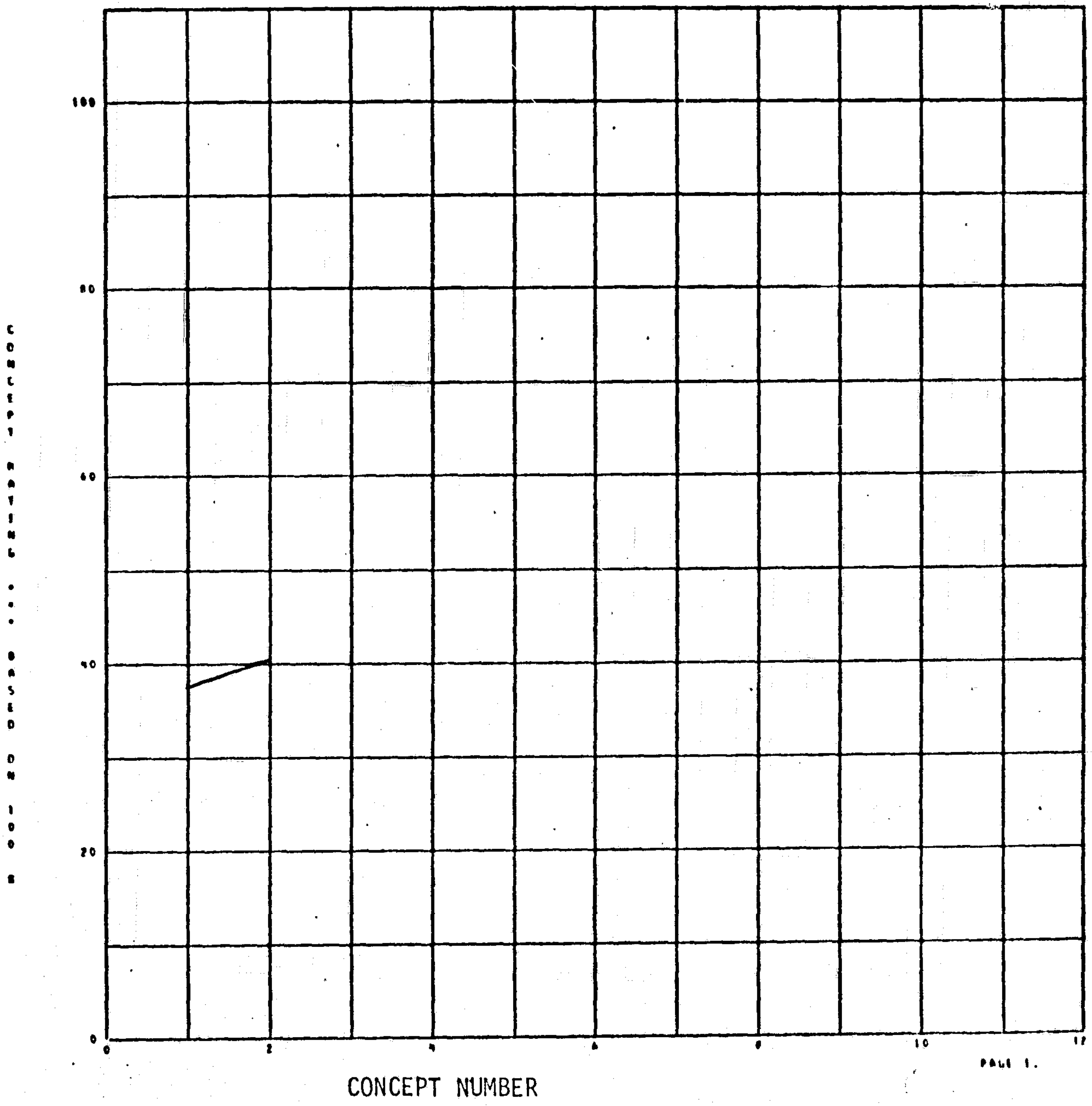


Figure 5-5. Ambient Food Storage (Shuttle) Concept Trade

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	-	SPACE RADIATOR
2	-	THERMOELECTRIC
3	-	AIR CYCLE-TURBINE/COMPRESSOR

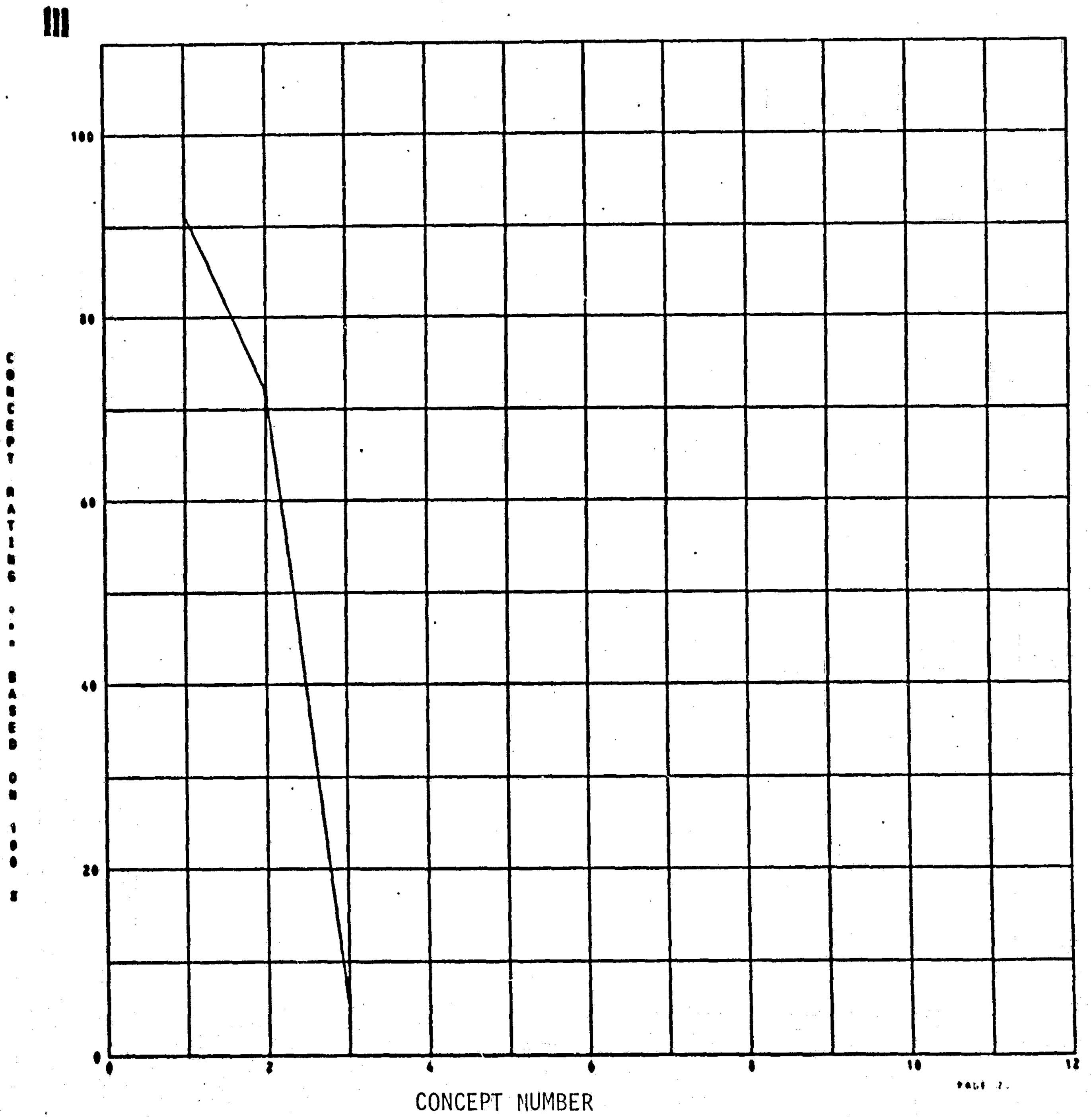


Figure 5-6. Refrigerated Food Storage (Shuttle) Concept Trade

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	SPACE RADIATOR
2 -	THERMOELECTRIC
3 -	AIR CYCLE-TURBINE/COMPRESSOR

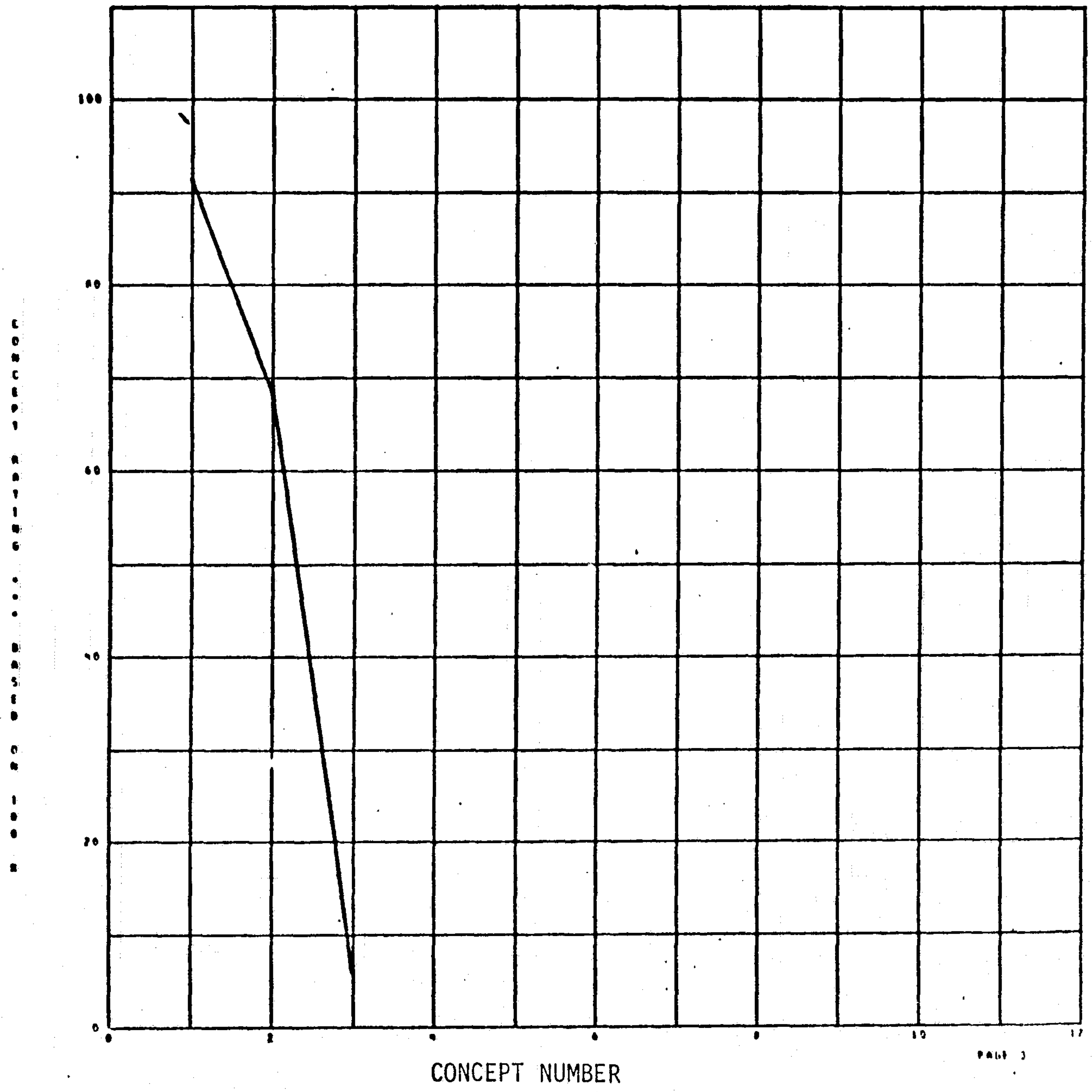


Figure 5-7. Frozen Food Storage (Shuttle) Concept Trade

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	HEATING TRAYS (SKYLAB)
2 -	OVEN-HOT AIR CONVECTION (ELECTRICAL HEAT)
3 -	OVEN-MICROWAVE (PLAIN)

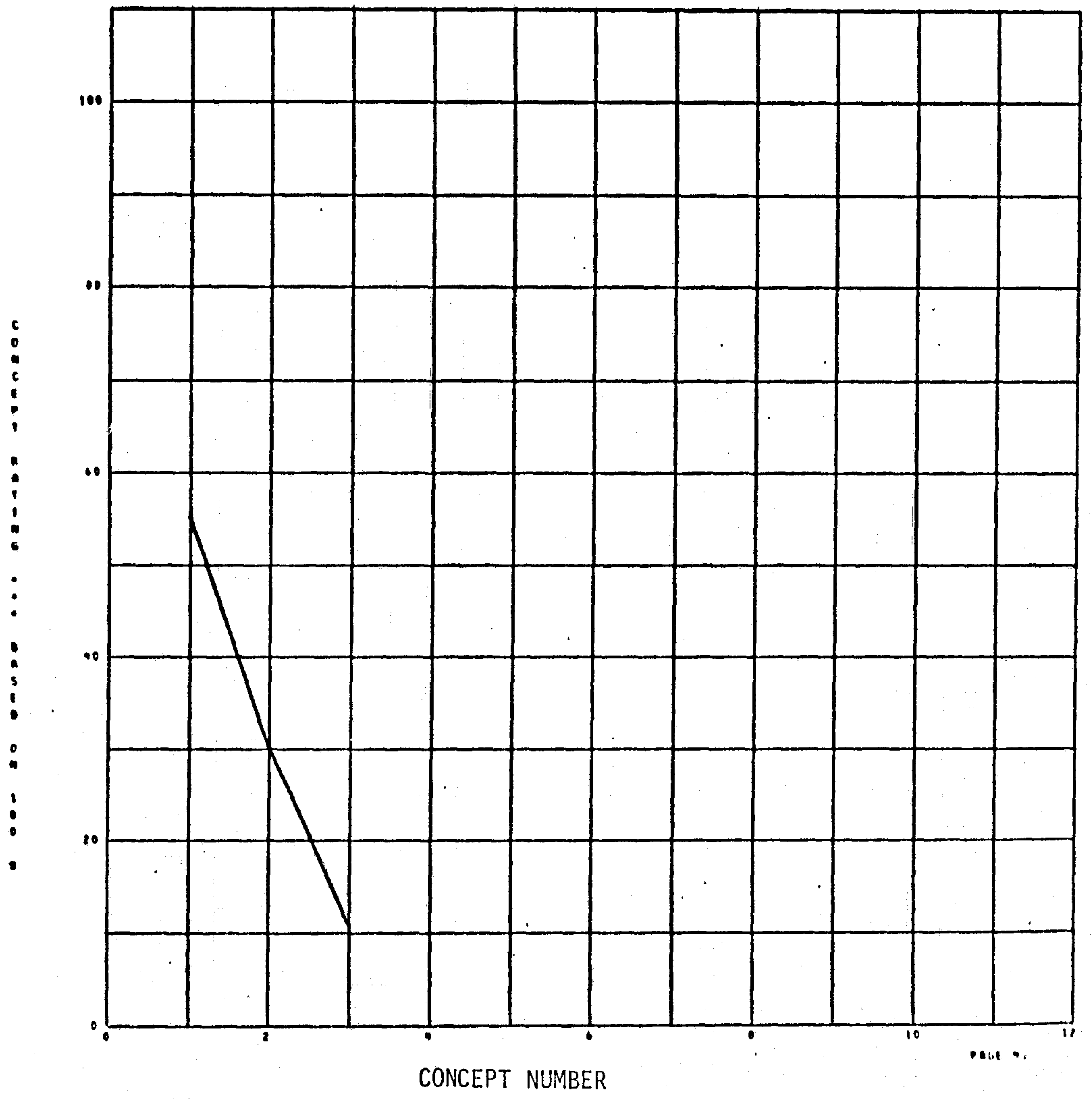
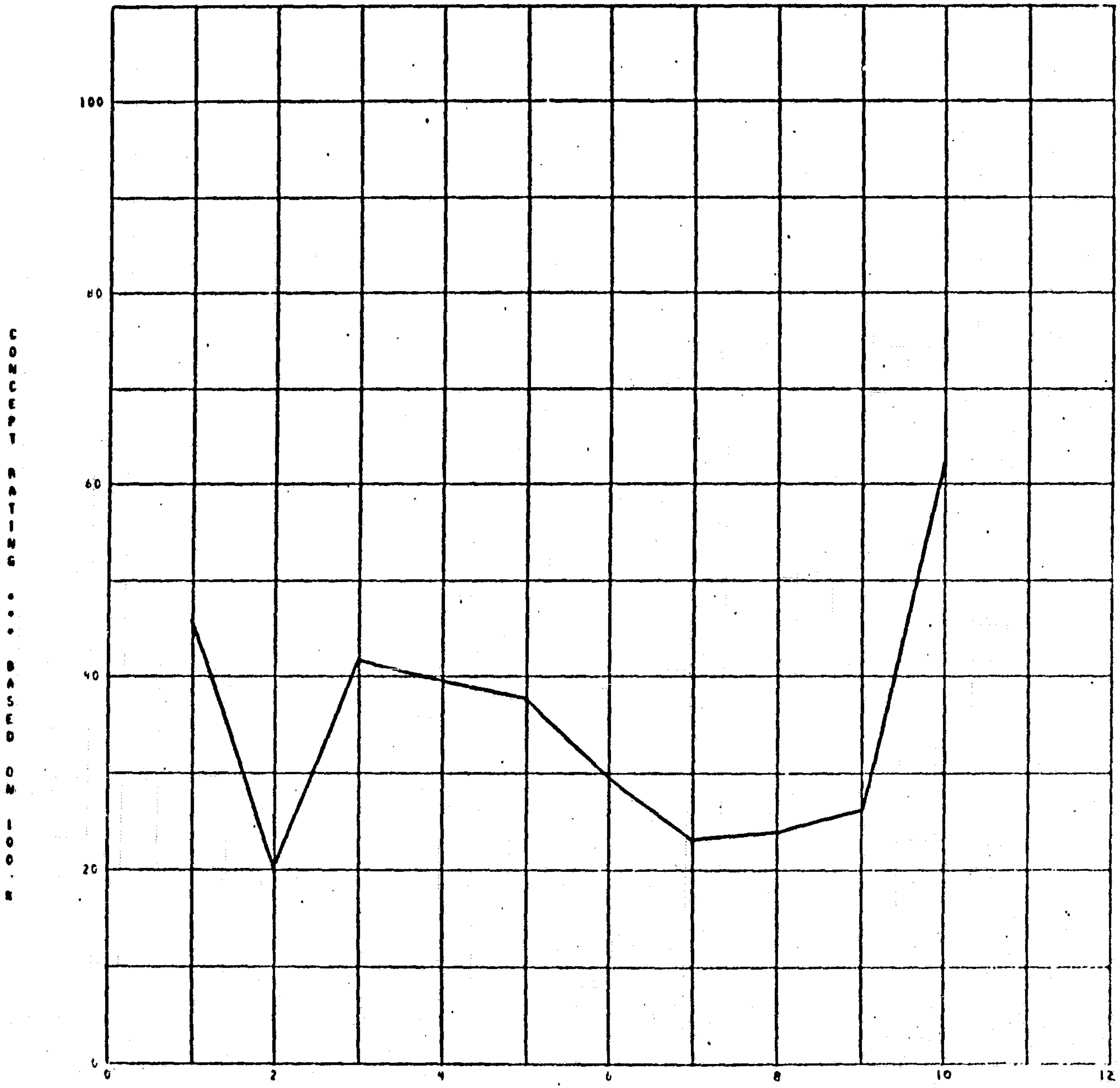


Figure 5-8. Food Warming (Shuttle) Concept Trade

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	-	HOT WATER SPRAY-CENTRIFUGE DRYING
2	-	HOT WATER SPRAY-AIR SPRAY DRY
3	-	HOT WATER SPRAY-FORCED HOT AIR ELECTRIC HEAT DRY
4	-	HOT WATER SPRAY-DESICCANT ELECTRICALLY DESORBED
5	-	HOT WATER SPRAY-FORCED HOT AIR DRY-THERMAL STORAGE
6	-	ULTRASONIC WASH-CENTRIFUGE DRYING
7	-	ULTRASONIC WASH-FORCRD HOT AIR DRYING
8	-	ULTRASONIC WASH-FORCED COLD DRY AIR-DESICCANT,ELECTRICALLY DESORBED
9	-	ULTRASONIC WASH-FORCED HOT AIR DRY-THERMAL STORAGE
10	-	MANUAL WASH-MANUAL WIPE DRY



CONCEPT NUMBER

Figure 5-9. Dishwasher/Dryer Combination (Shuttle) Concept Trade

APPLIANCE CONCEPT NO. — CONCEPT NAME

1 - HOT WATER SPRAY-CENTRIFUGE DRYING
2 - HOT WATER SPRAY-FORCED HOT AIR ELECTRIC HEAT DRYING
3 - HOT WATER SPRAY-FORCED AIR/DISICCANT/ELECTRICALLY HEATED
4 - MANUAL WASH-MANUAL WIPE
5 - DISPOSABLE CUPS-REUSABLE METALLIC UTENSILS AND DISHES
6 - DISPOSABLE CUPS AND NONMETALLIC DISHES-REUSABLE METALLIC UTENSILS
7 - DISPOSABLE CUPS AND NONMETALLIC UTENSILS-REUSABLE METALLIC DISHES
8 - DISPOSABLE CUPS AND NONMETALLIC UTENSILS AND DISHES
9 - REUSABLE CUPS AND METALLIC UTENSILS AND DISHES
10 - REUSABLE CUPS AND METALLIC UTENSILS-DISPOSABLE NONMETALLIC DISHES
11 - REUSABLE CUPS AND METALLIC DISHES--DISPOSABLE NONMETALLIC UTENSILS
12 - REUSABLE CUPS-DISPOSABLE NONMETALLIC UTENSILS AND DISHES

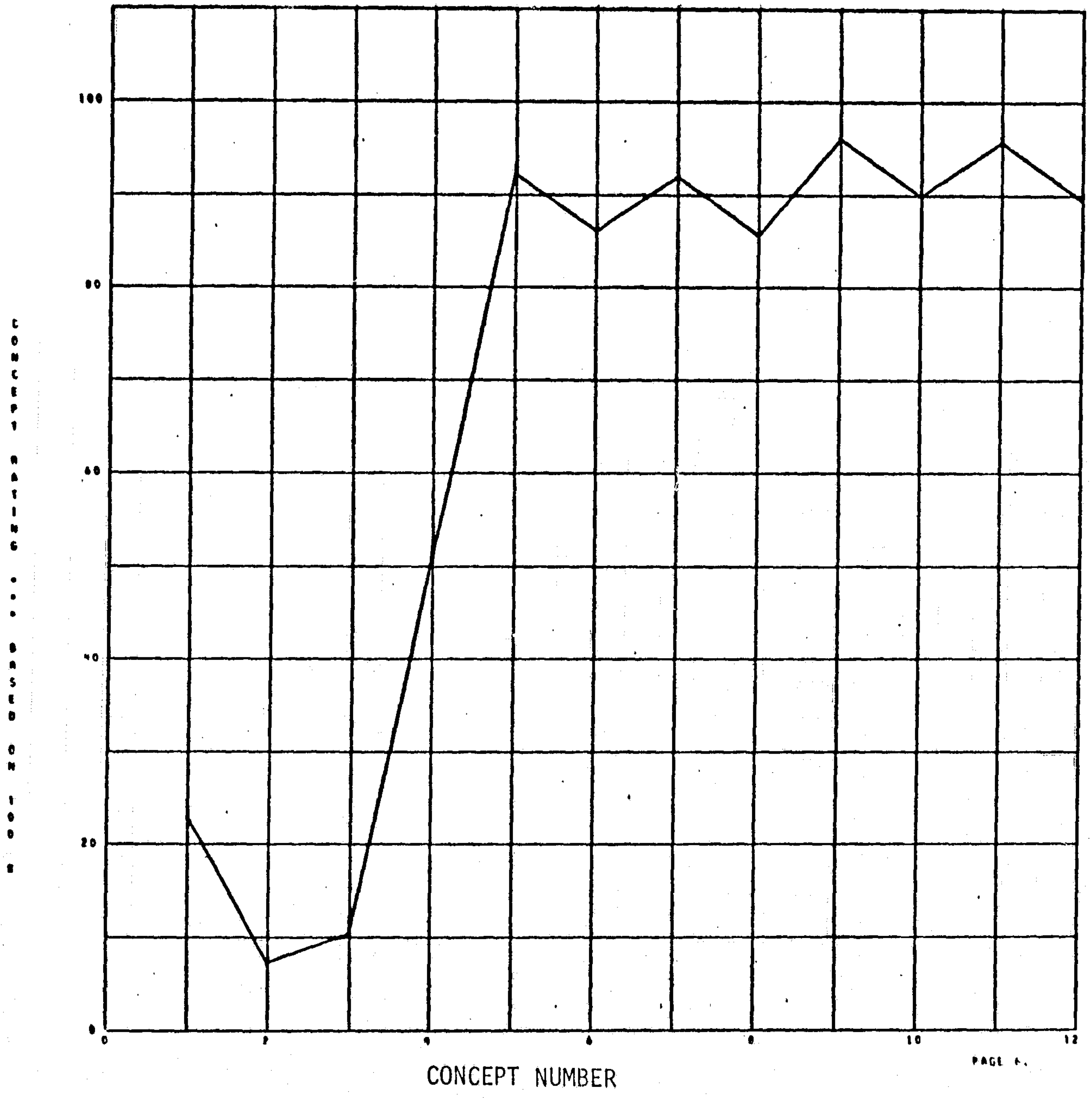


Figure 5-10. Dishwasher/Dryer with Dishes (Shuttle) Concept Trade

APPLIANCE CONCEPT NO.	CONCEPT NAME
1	DRY JOHN
2	DRY JOHN-ANAL WASH
3	GERMICIDE
4	INTEGRATED VACUUM DECOMPOSITION
5	FLUSH FLOW OXYGEN INCINERATION
6	PYROLYSIS/BATCH INCINERATION
7	WET OXIDIZATION
8	SEMIAUTOMATIC BAG SYSTEM (SKYLAB)
9	DRY BAGS (APOLLO)

Figure 5-11. Fecal Collection/Transfer (Shuttle) Concept Trade

APPLIANCE CONCEPT NO. — CONCEPT NAME

1 - STANDUP URINAL
2 - COMMODE URINAL
3 - INTIMATE MALE ADAPTER (SKYLAB)
4 - APERTURE URINAL
5 - LIQUID/GAS FLOW CUFF TYPE (APOLLO)

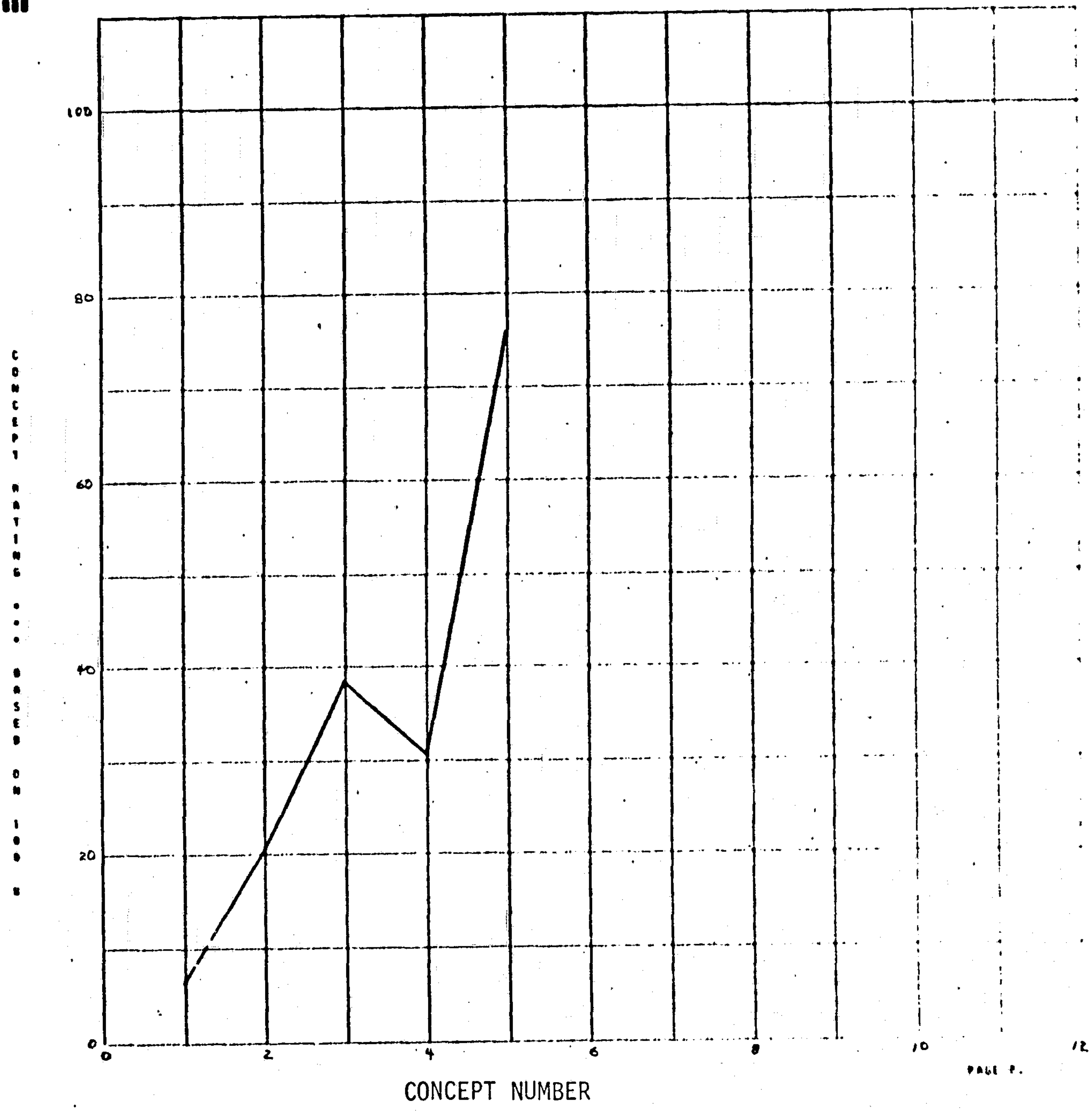


Figure 5-12. Urine Collection/Transfer (Shuttle) Concept Trade

APPLIANCE CONCEPT NO. — CONCEPT NAME

1 - INTIMATE PERSONAL ADAPTOR,DISPOSABLE (MATES WITH COMMODE)
2 - INTIMATE PERSONAL ADAPTOR,DISPOSABLE (MATES WITH COMMODE)
3 - PORTABLE DISPOSABLE COLLECTOR (TYPE USE COMMERCIALLY)
4 - REUSABLE PORTABLE COLLECTOR

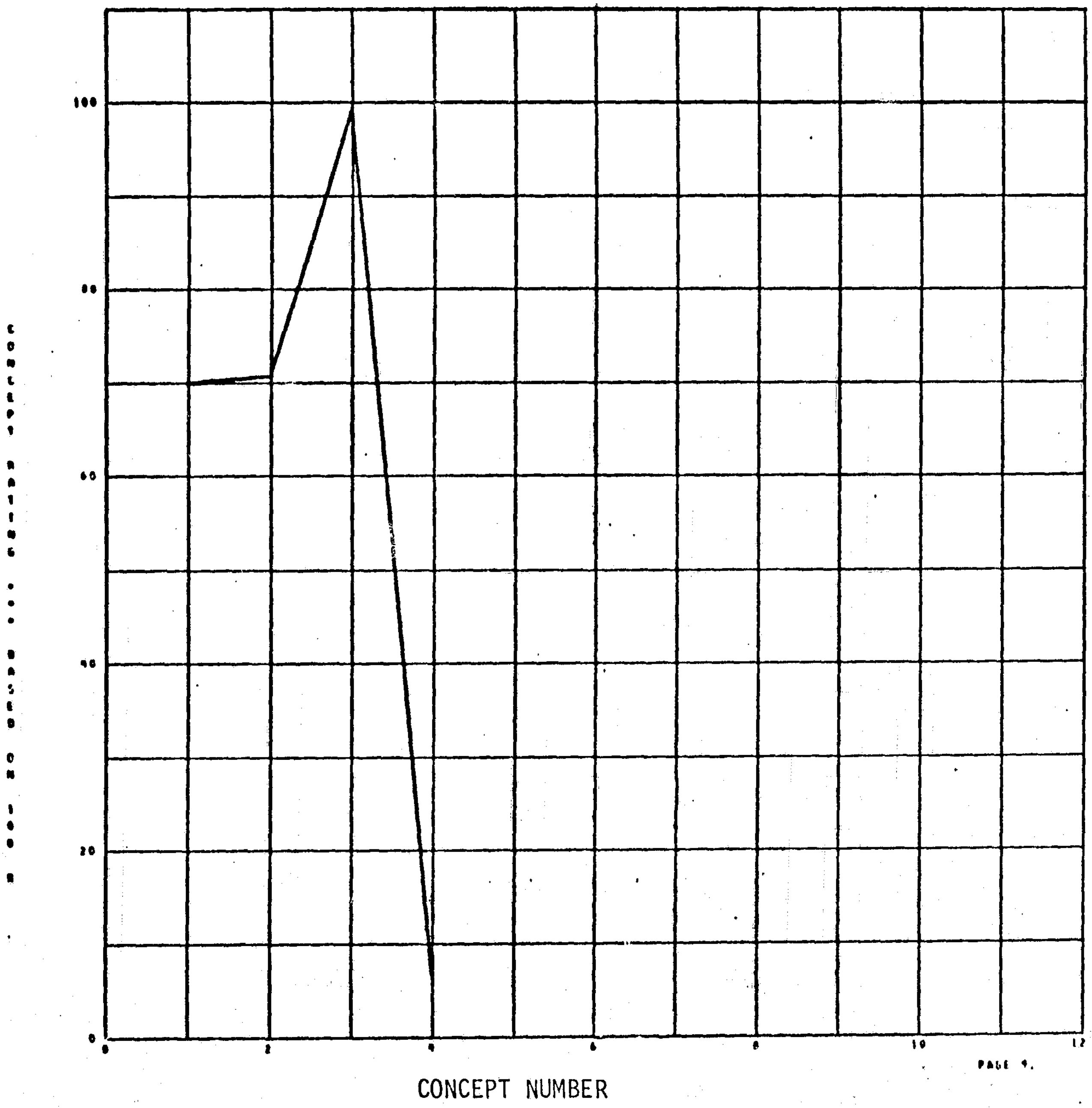


Figure 5-13. Vomitus Collection/Transfer (Shuttle) Concept Trade

APPLIANCE
CONCEPT
NO. C O N C E P T N A M E

1 = VACUUM PICKUP
2 = AIR DRAG
3 = MECHANICAL
4 = COLLAPSIBLE

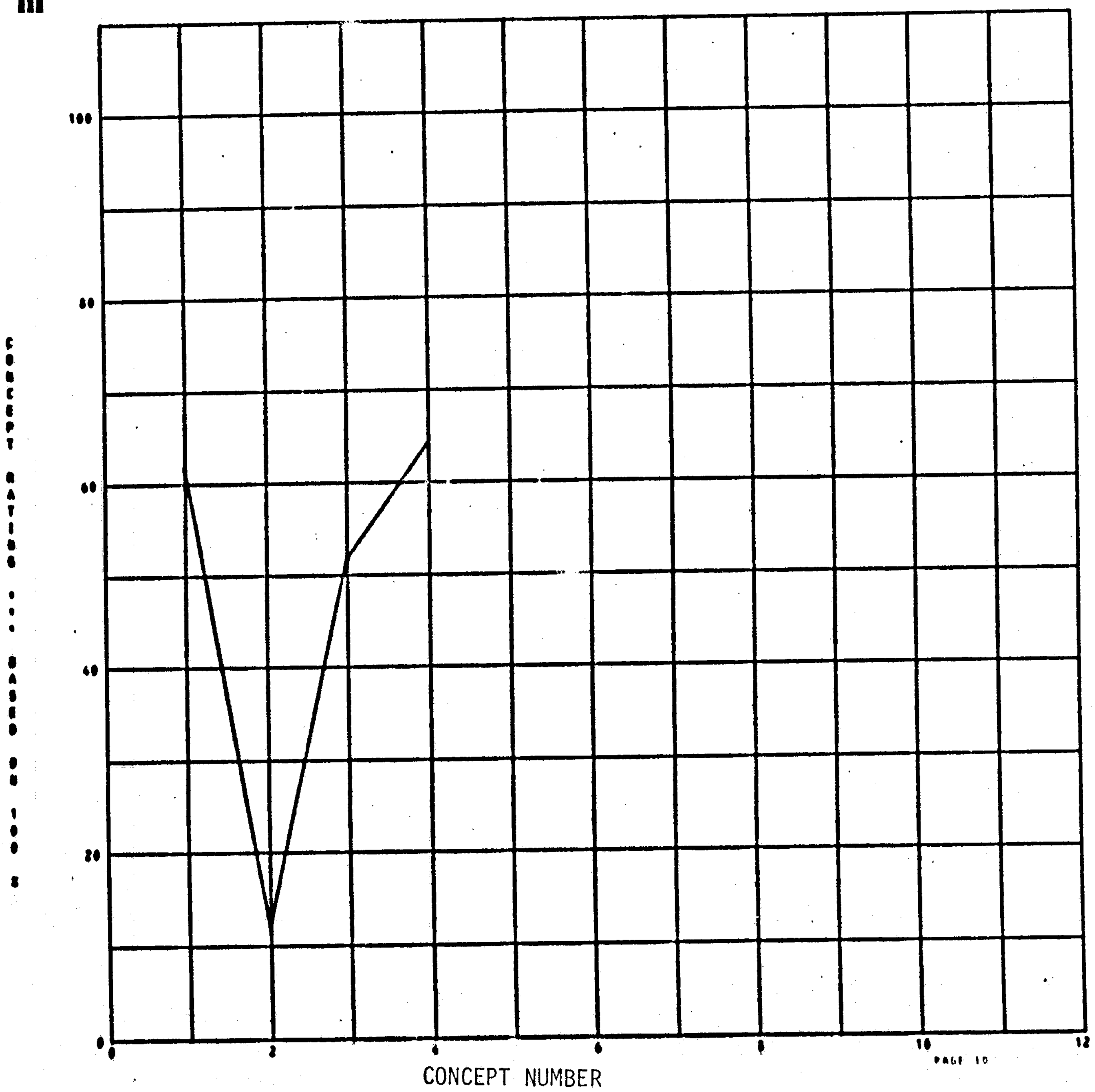


Figure 5-14. Whole Body Shower (Shuttle) Concept Trade

APPLIANCE CONCEPT NO.	CONCEPT NAME
1	DISPOSABLE WET WIPES
2	REUSABLE WET WIPES
3	DISPOSABLE WIPES (PREPACKAGED)
4	AUTOMATIC SPONGE
5	REUSABLE WASHCLOTHES
6	DISPOSABLE WASHCLOTHES (SKYLAB)

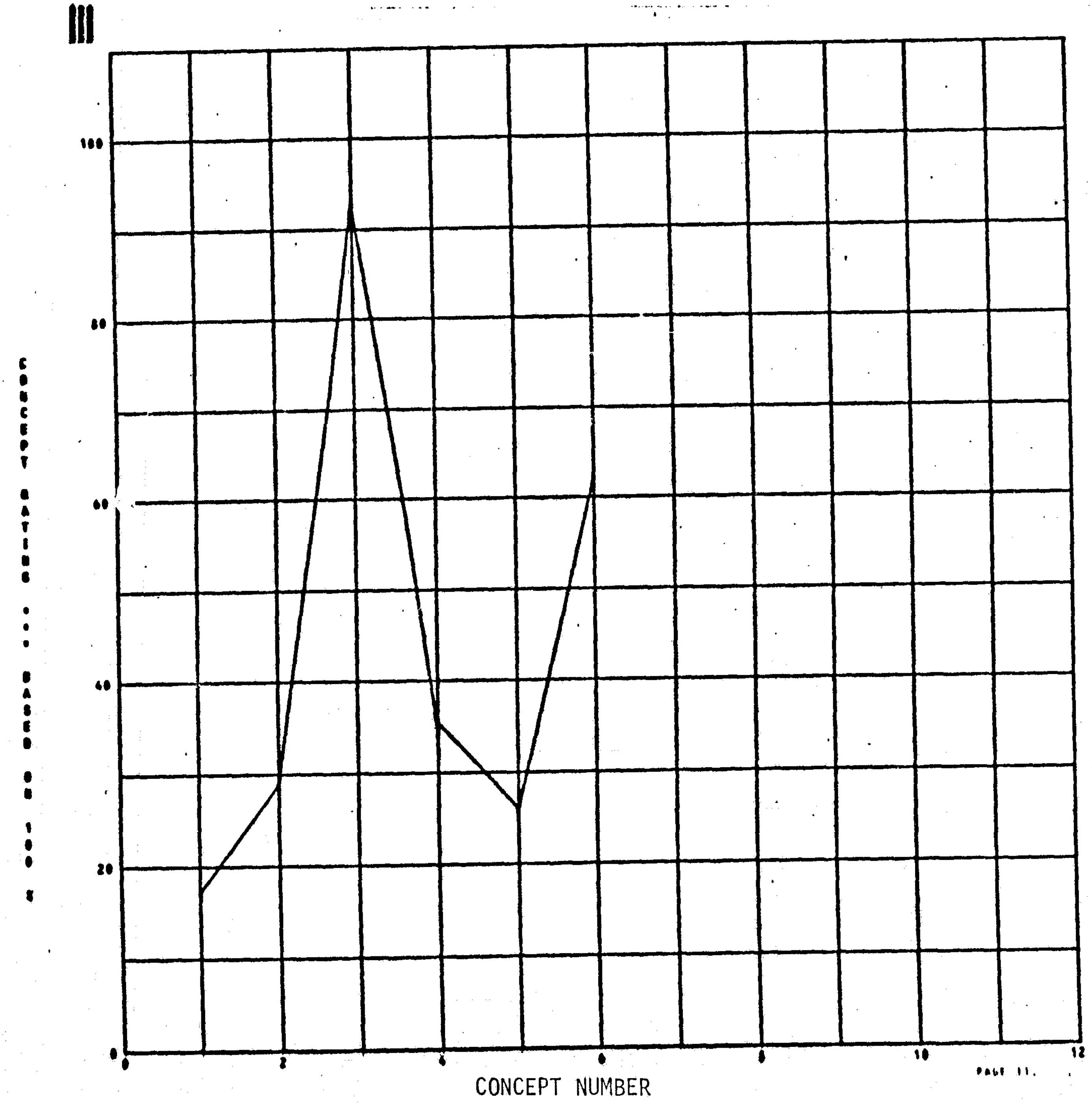


Figure 5-15. Partial Body Washing (Shuttle) Concept Trade

APPLIANCE
CONCEPT
NO. CONCEPT NAME

1 = REUSABLE DRY WIPES
2 = DISPOSABLE DRY WIPES
3 = ELECTRIC DRYER

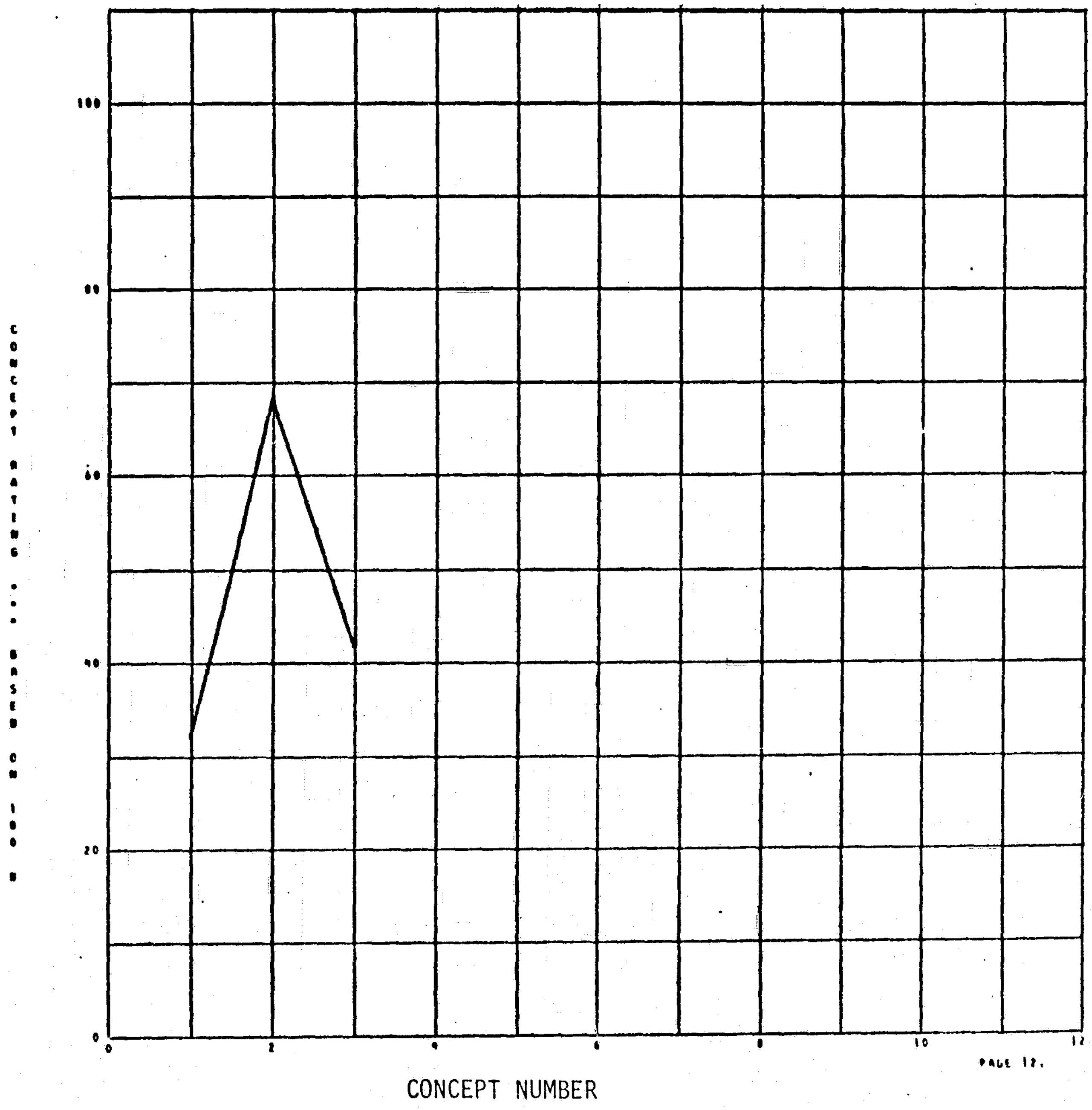
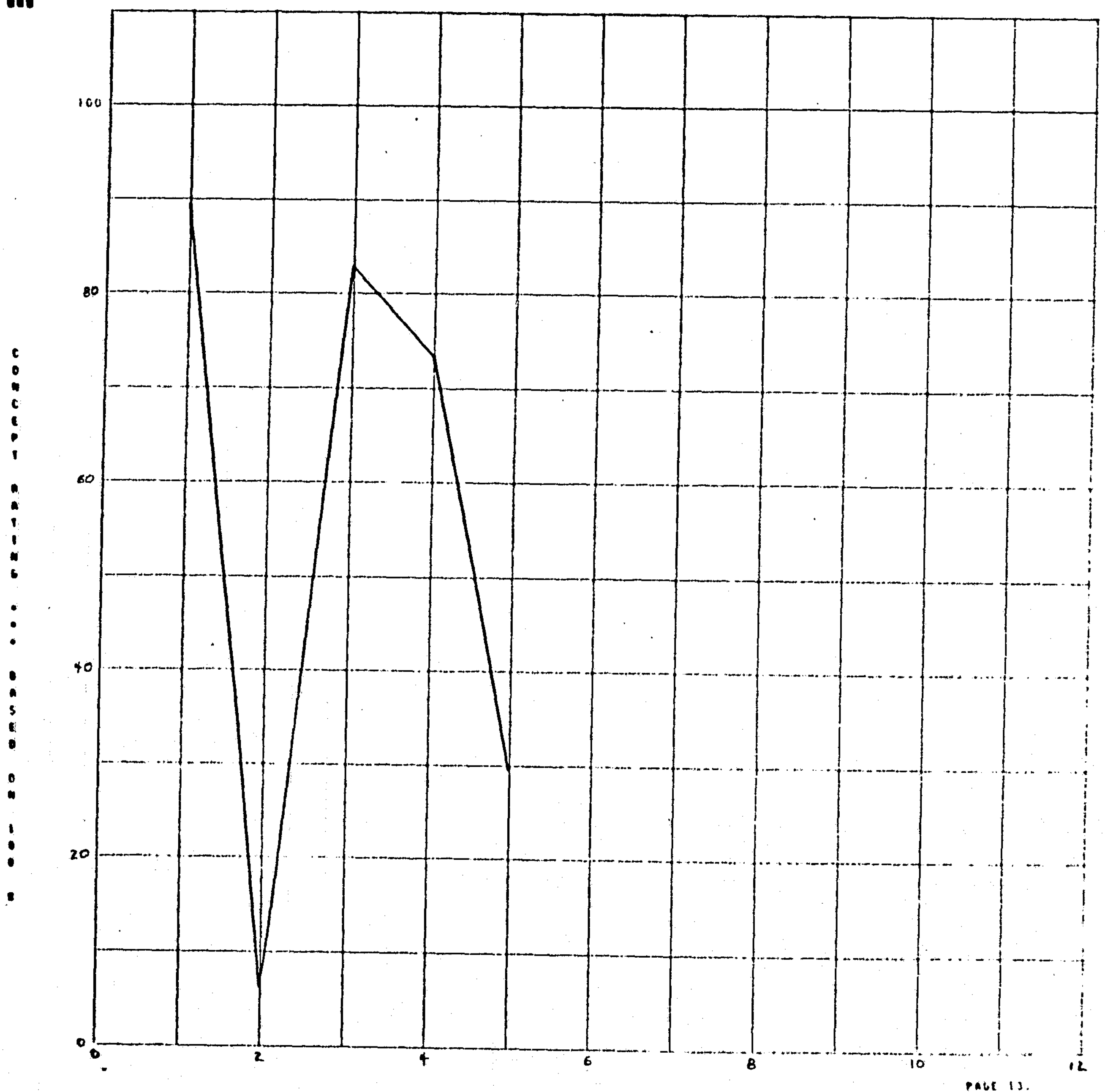


Figure 5-16. Partial Body Drying (Shuttle) Concept Trade

APPLIANCE
CONCEPT
NO. CONCEPT NAME

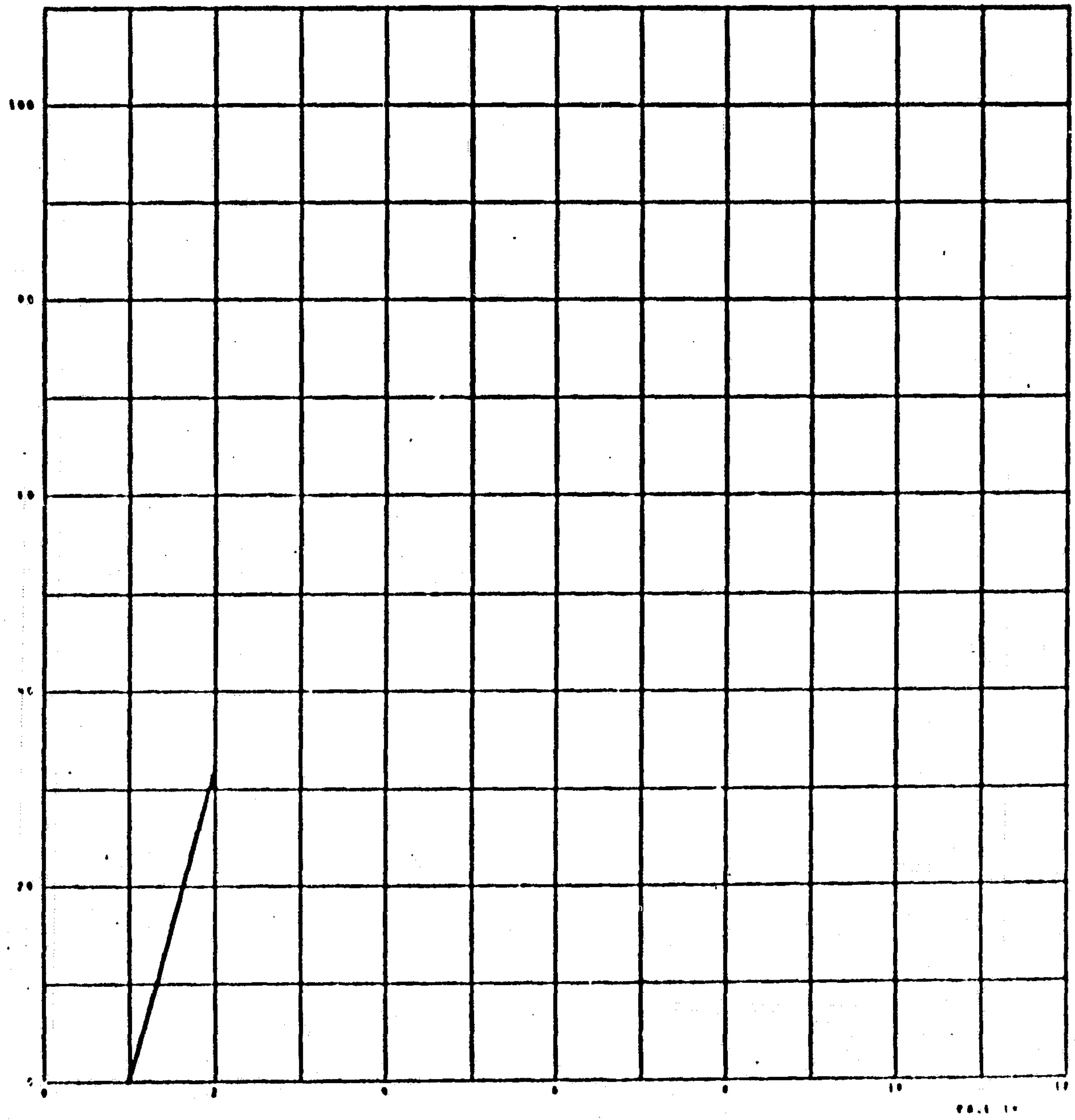
1 - WET SHAVE WITH SAFETY RAZOR AND CREAM
2 - DRY SHAVE-ELECTRIC RAZOR/VACUUM COLLECTION
3 - DRY SHAVE-WINDUP RAZOR
4 - DRY SHAVE-VACUUM DRIVEN RAZOR
5 - WET SHAVE-SAFETY RAZOR/VACUUM



CONCEPT NUMBER

Figure 5-17. Shaving (Shuttle) Concept Trade

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	=	POWER CLIPPER/VACUUM COLLECTION
2	=	RAZOR COMB/VACUUM COLLECTION



CONCEPT NUMBER

Figure 5-18. Hair Cutting (Shuttle) Concept Trade

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	TOOTHPASTE WITH DENTIFRICE
2 -	WATER PIX
3 -	ELECTRIC TOOTHBRUSH

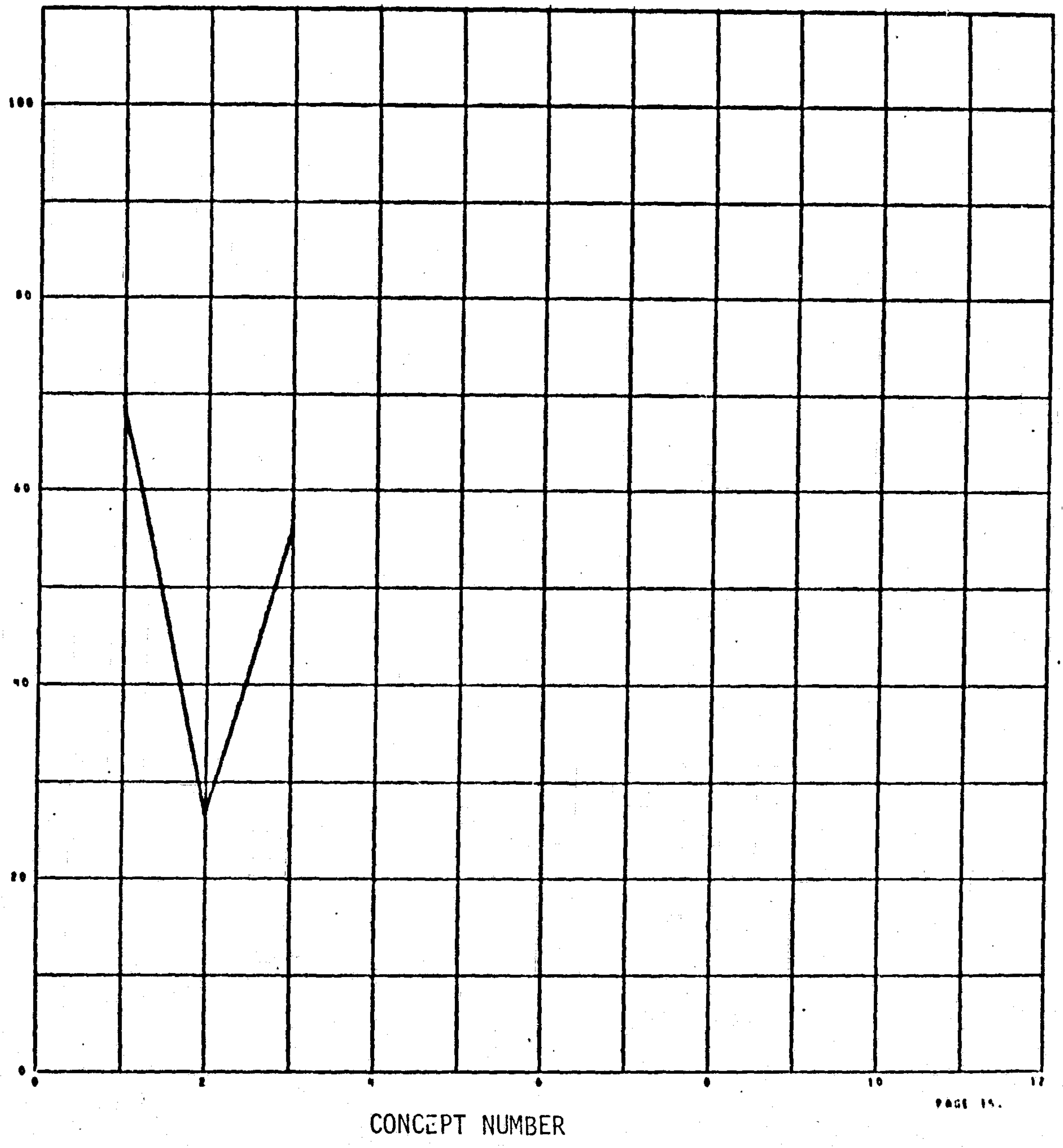


Figure 5-19. Dental (Shuttle) Concept Trade

APPLIANCE CONCEPT NO.	CONCEPT NAME
1	DISPOSABLE WET/DRY WIPES
2	REUSABLE WET WIPES-DISPOSABLE DRY WIPES
3	DISPOSABLE WET/DRY WIPES (PREPACKAGED)
4	AUTOMATIC SPONGE MOP
5	REUSABLE CLEANING CLOTHS DISPOSABLE DRY WIPES
6	DISPOSABLE CLEANING CLOTHS (SKLAB) DISPOSABLE DRY WIPES
7	DISPOSABLE WET WIPES REUSABLE DRY WIPES
8	REUSABBLE WET/DRY WIPES
9	REUSABLE CLEANING CLOTHS/DRY WIPES
10	DISPOSABLE CLEANING CLOTHS REUSABLE DRY WIOES

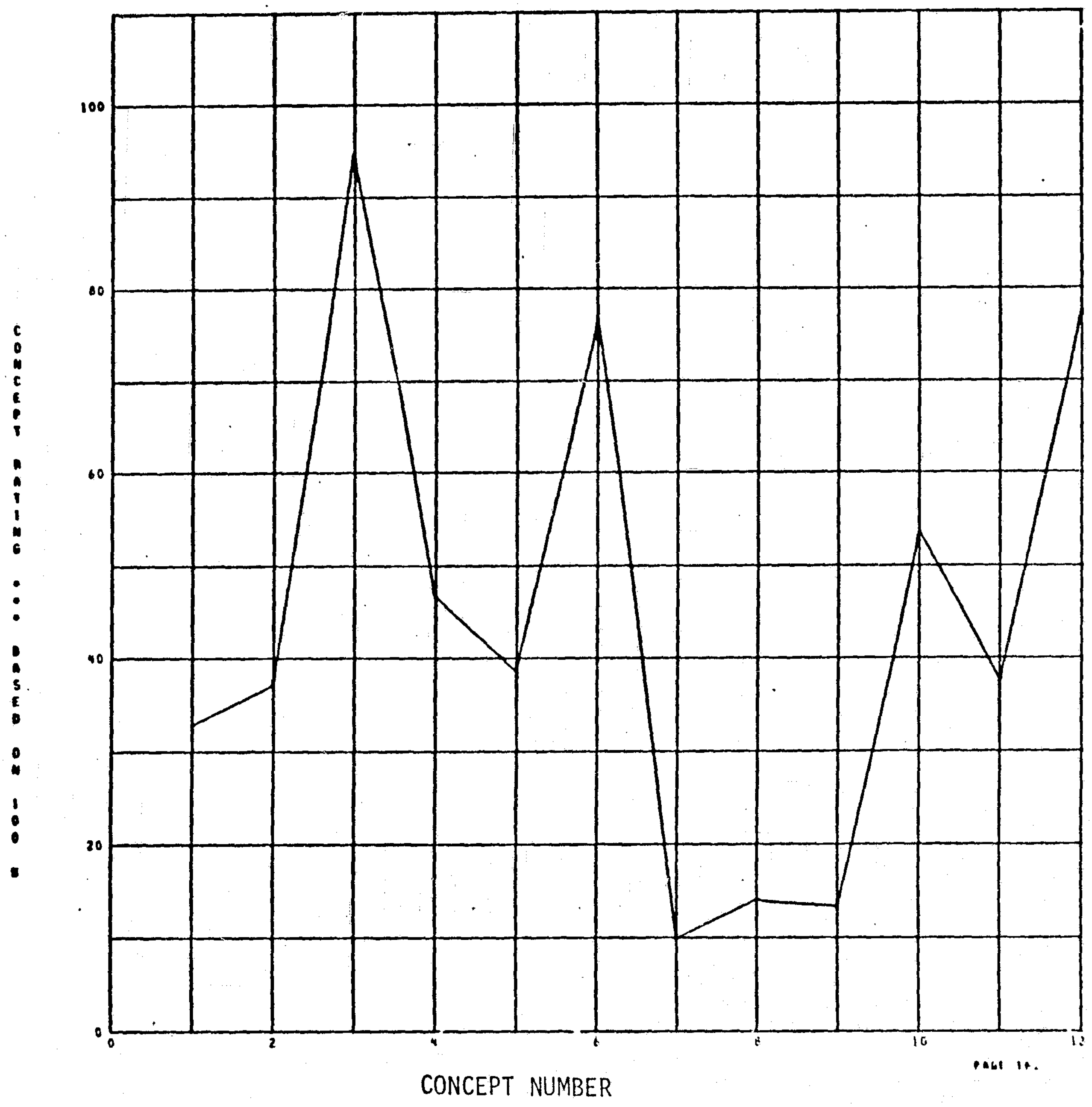


Figure 5-20. Surface Wiping (Shuttle) Concept Trade

APPLIANCE CONCEPT NO. CONCEPT NAME

1 - DISPOSABLE TRASH BAG
2 - REUSABLE WASTE RECEPTICLES
3 - DISPOSABLE WASTE RECEPTICLES

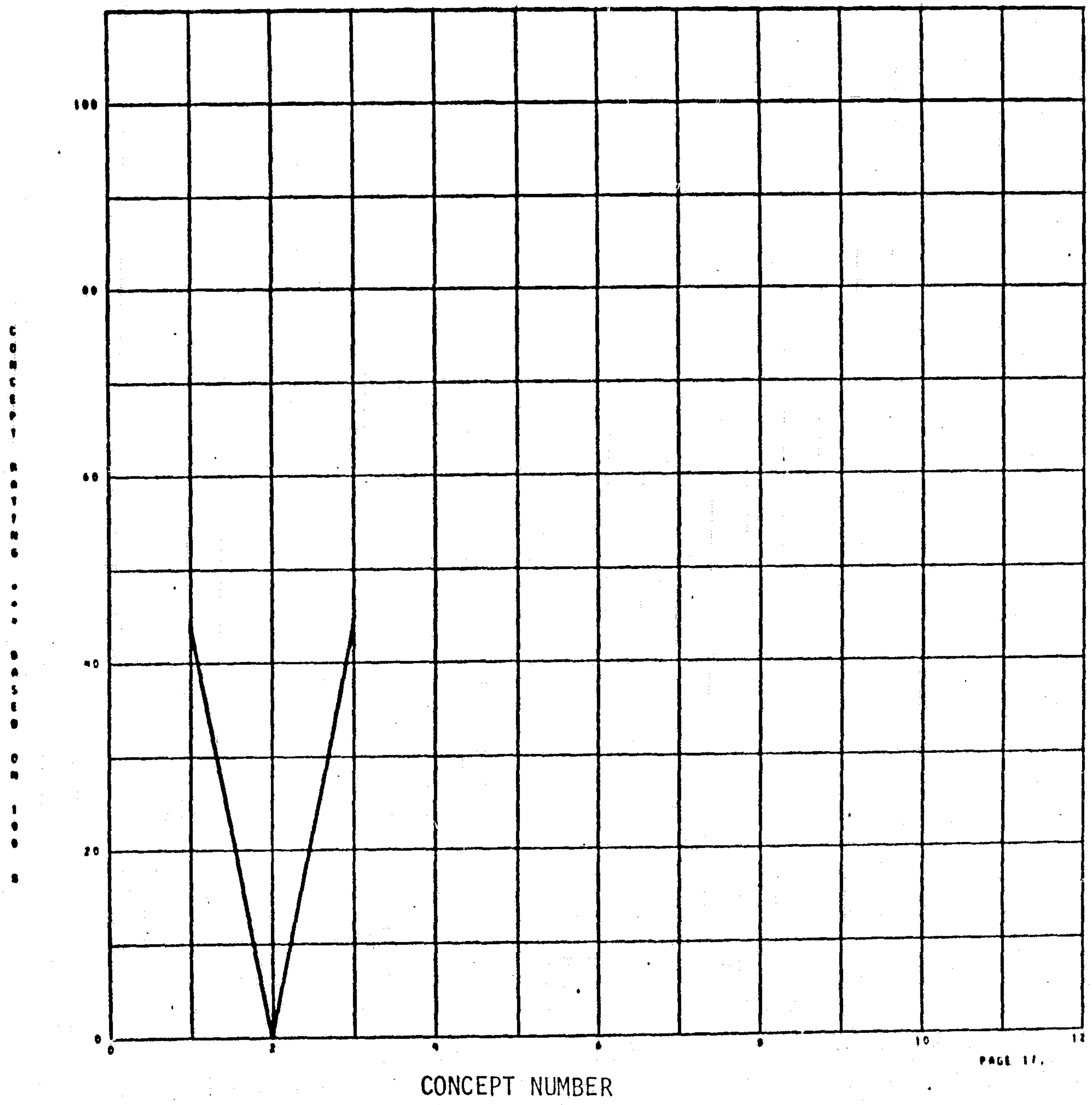


Figure 5-21. Manual Refuse Collection (Shuttle) Concept Trade

APPLIANCE CONCEPT NO. — CONCEPT NAME

1 - VACUUM CLEANER (SKYLAB)
2 - VACUUM CLEANER (COMMERICAL)
3 - VACUUM CLEANER-VENTED TO SPACE

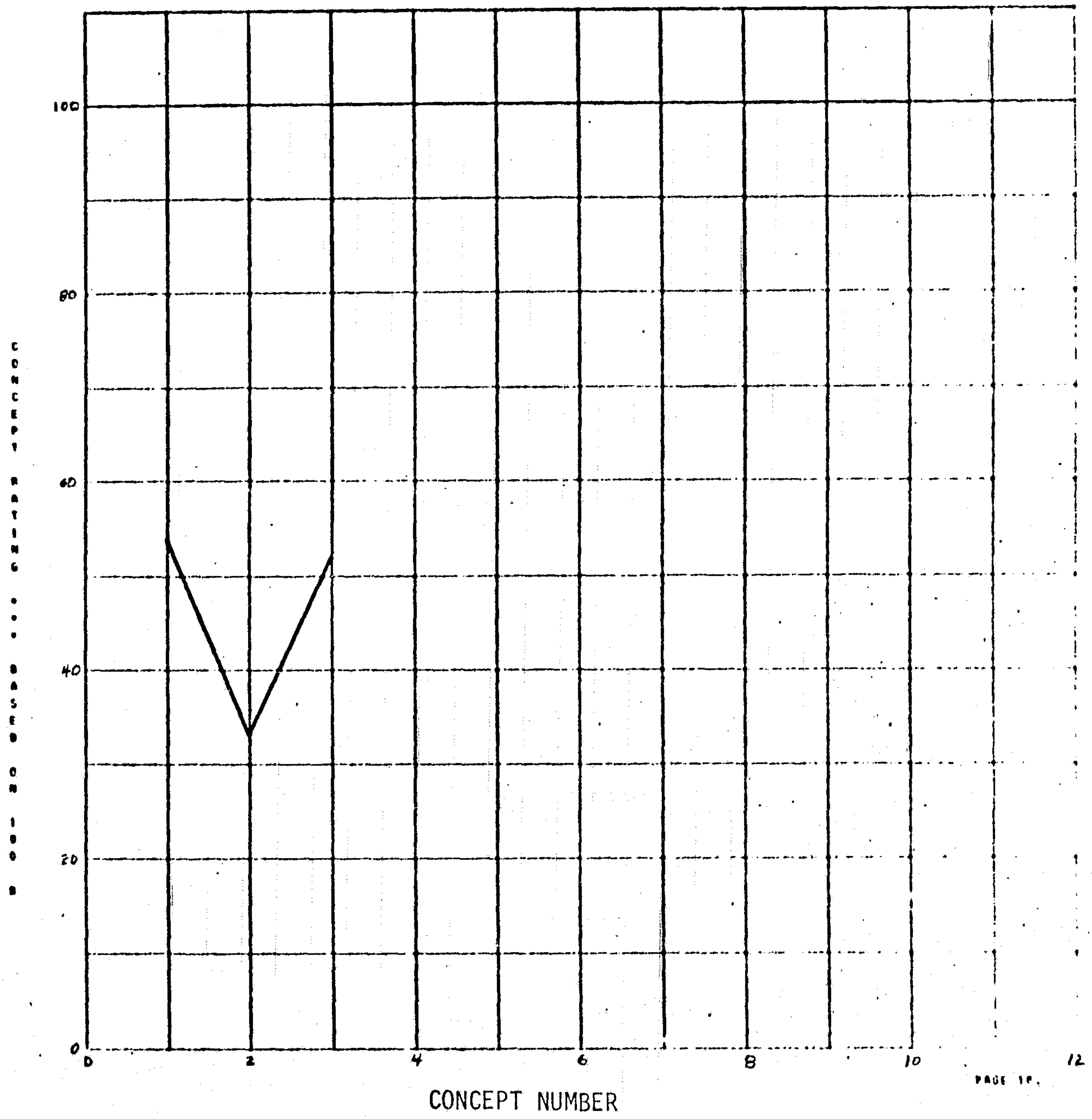


Figure 5-22. Vacuum Refuse Collection (Shuttle) Concept Trade

APPLIANCE CONCEPT NO. — CONCEPT NAME

1 - COMPACTOR-AIR PRESSURE
2 - COMPACTOR-VACUUM
3 - COMPACTOR-MOTOR
4 - COMPACTOR-MANUAL
5 - COMPACTOR-AIR PRESSURE W/SHREDDER
6 - COMPACTOR-VACUUM W/SHREDDER
7 - COMPACTOR-MOTOR W/SHREDDER
8 - COMPACTOR-MANUAL W/SHREDDER
9 - INTEGRATED VACUUM DECOMPOSTION/SHREDDER
10 - FLUSH FLOW OXYGEN INCINERATION/SHREDDER
11 - PYROLYSIS/BATCH INCINERATION/SHREDDER
12 - WET OXIDIZATION/ SHREDDER

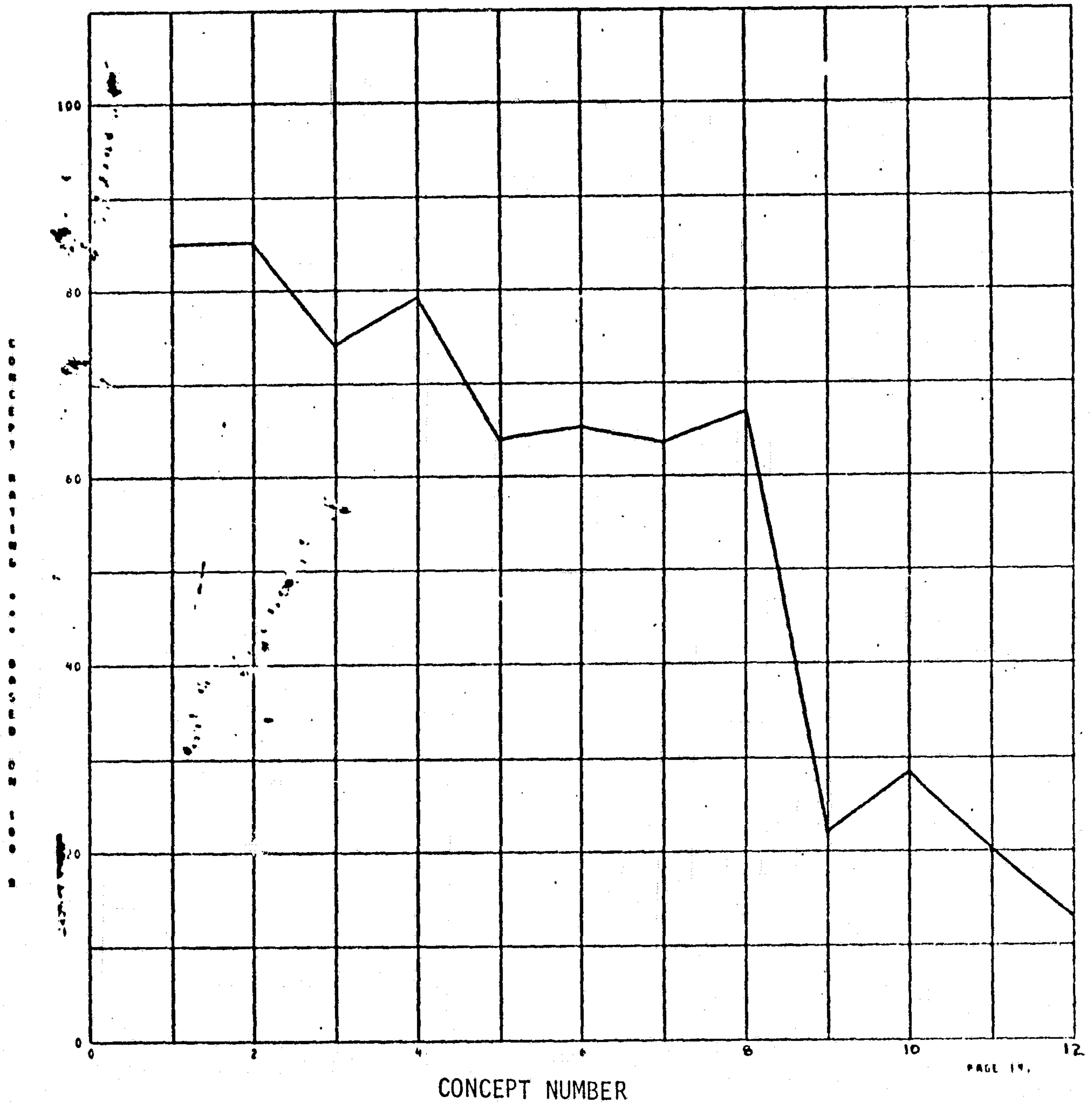


Figure 5-23. Refuse Processing (Shuttle) Concept Trade

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	=	VACUUM STORAGE
2	=	STORAGE BIN/CONTAINER
3	=	SOLID PROPELLANT REFUSE ROCKET

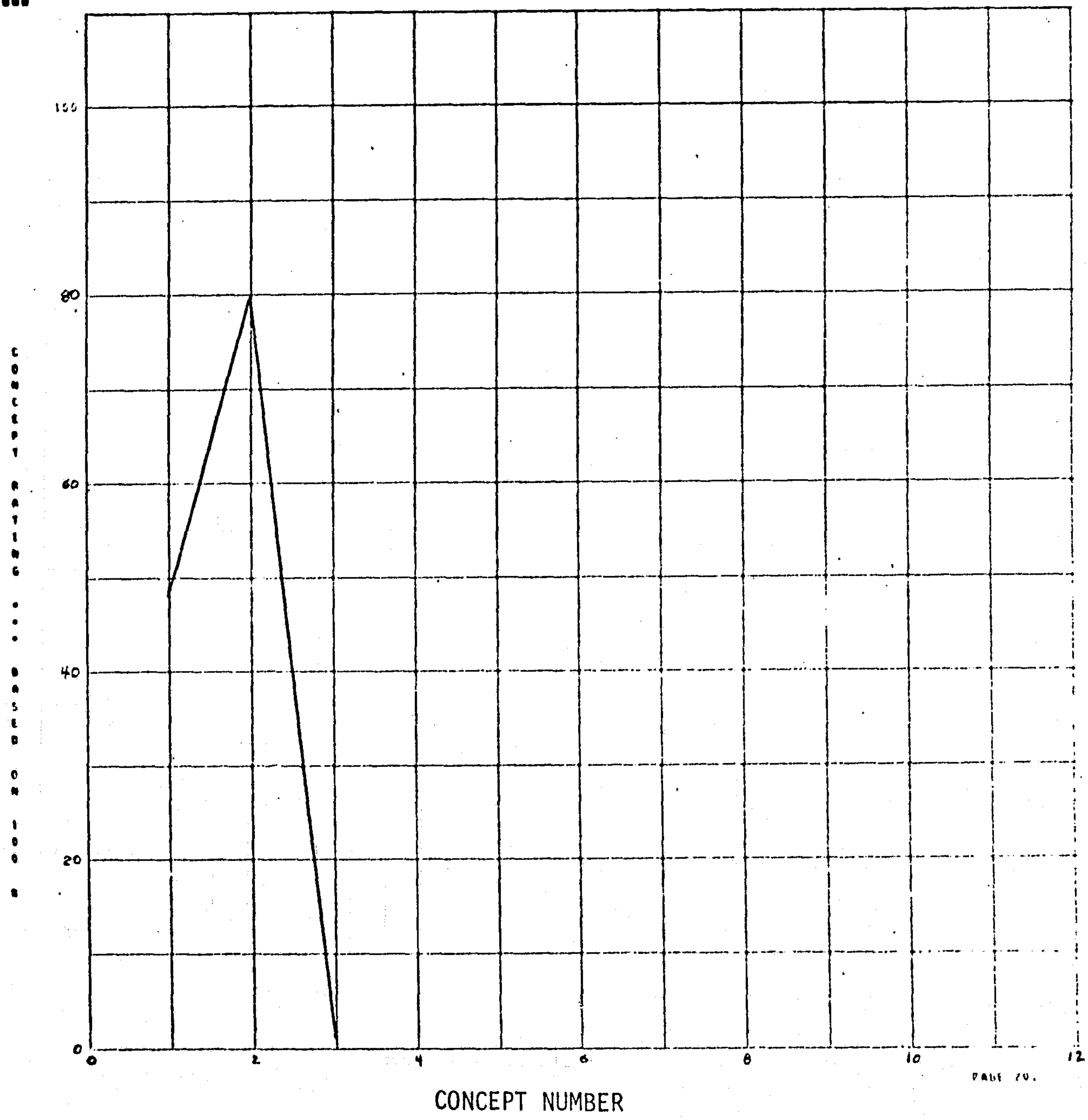


Figure 5-24. Refuse Disposal (Shuttle) Concept Trade

APPLIANCE CONCEPT NO. — CONCEPT NAME

1 - MECHANICAL OSCILLATION
2 - FLUIDIC AGITATION
3 - PISTON AGITATION
4 - CYCLIC VALVE AND PUMP AGITATION
5 - DIAPHRAM ACTUATED-ONE DIRECTIONAL SQUEEZE
6 - DIAPHRAM ACTUATED-TWO DIRECTIONAL SQUEEZE
7 - WATER SPRAY AGITATED
8 - ULTRASONIC
9 - MANUAL WASHBOARD
10 - PLAIN RECIRCULATION

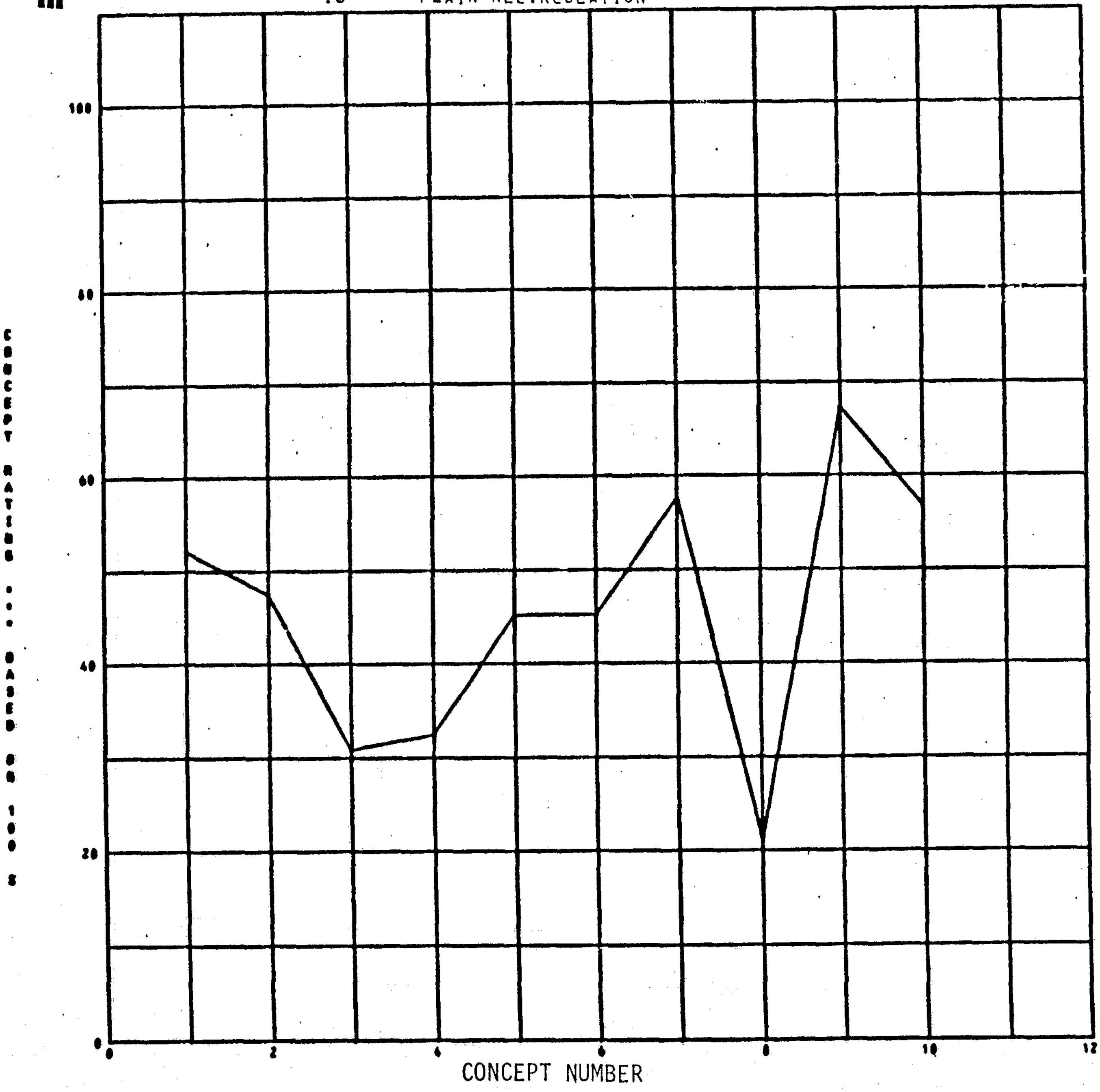


Figure 5-25. Garment/Linen Washing (Shuttle) Concept Trade

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	-	FORCED HOT AIR-ELECTRIC
2	-	FORCED HOT AIR-HEAT FROM THERMAL STORAGE UNIT
3	-	FORCED COLD DRY AIR-DISICCANT(VACUUM REGENERABLE)
4	-	FORCED COLD DRY AIR-DISICCANT(ELECTRIC HEAT REGENERABLE)
5	-	VACUUM DRY
6	-	THERMAL VACUUM DRY-ELECTRIC HEAT
7	-	THERMAL VACUUM DRY-THERMAL STORAGE/RADIANT HEAT
8	-	CLOTHES LINE-FORCED CONVECTION
9	-	CLOTHES LINE-FORCED CONVECTION+ELECTRIC HEAT

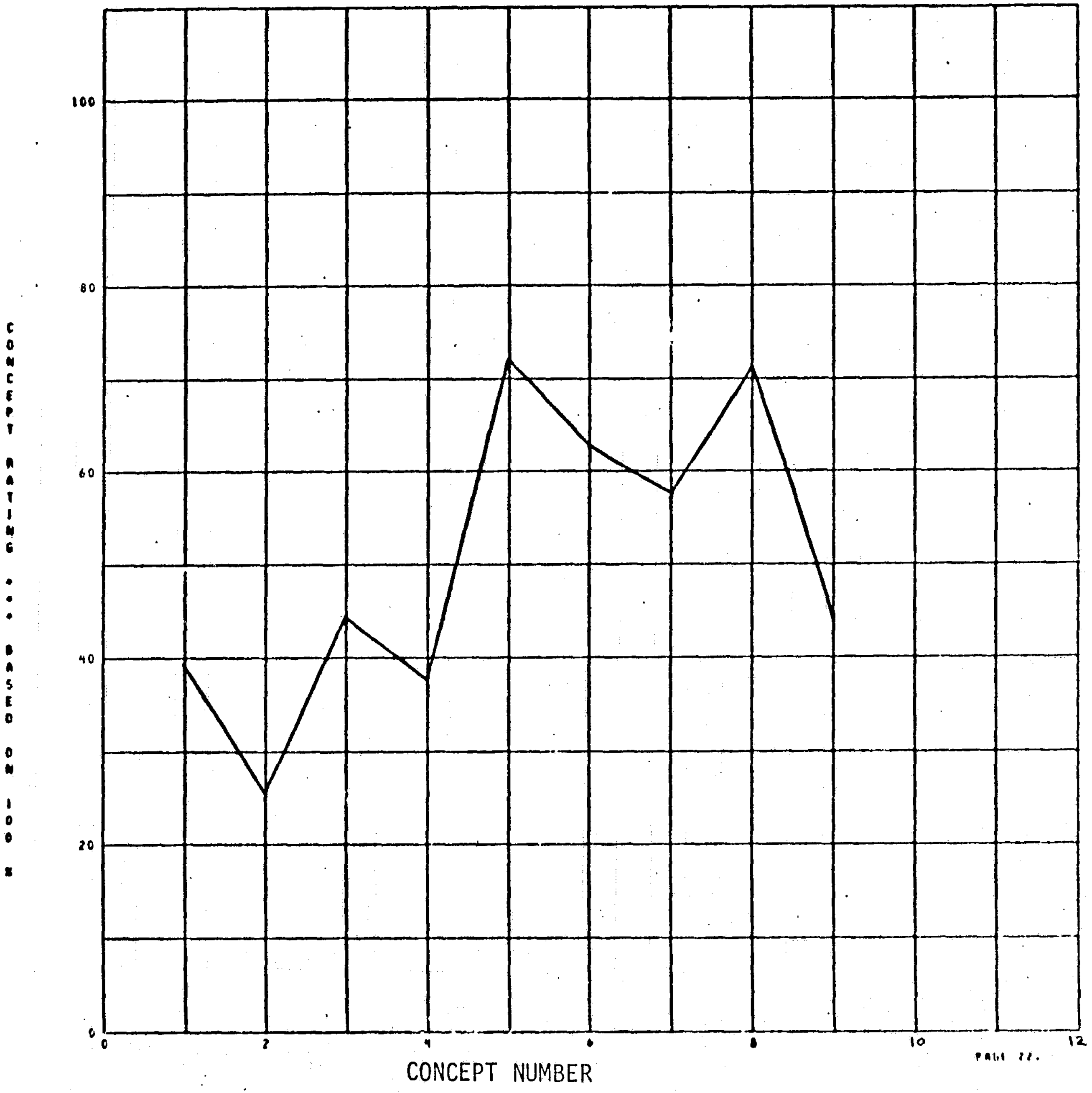


Figure 5-26. Garment/Linen Drying (Shuttle) Concept Trade

APPLIANCE CONCEPT NO.	CONCEPT NAME
1	FLUIDIC AGITATION/FORCED HOT AIR-ELECTRIC HEATER
2	FLUIDIC AGITATION/FORCED HOT AIR-THERMAL STORAGE HEATER
3	FLUIDIC AGITATION/FORCED AIR DRYING-CLOTHES LINE
4	FLUIDIC AGITATION/FORCED AIR DRYING-CLOTHES LINE
5	WATER SPRAY AGITATION/FORCED HOT AIR-ELECTRIC HEATER
6	WATER SPRAY AGITATION/FORCED HOT AIR-THERMAL STORAGE HEATER
7	WATER SPRAY AGITATION/FORCRD AIR DRYING-CLOTHES LINE
8	WATER SPRAY AGITATION/ELECTRICALLY HEATED-CLOTHES LINE
9	DISPOSABLE CLOTHES

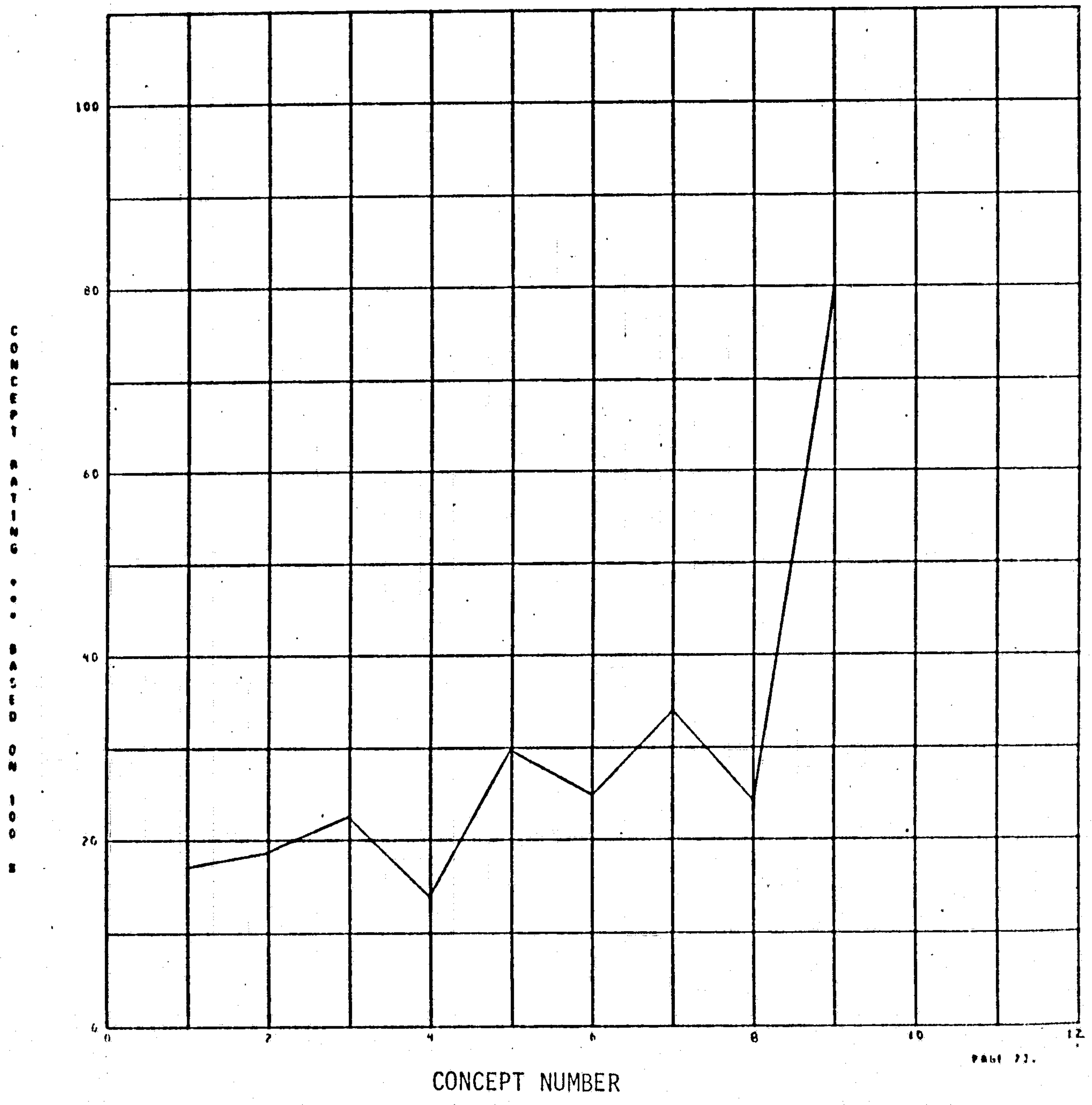


Figure 5-27. Garment/Linen Washer/Dryer-Disposable Clothes (Shuttle) Concept Trade

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	=	MOIST HEAT
2	=	DRY HEAT
3	=	ETHYLENE OXIDE

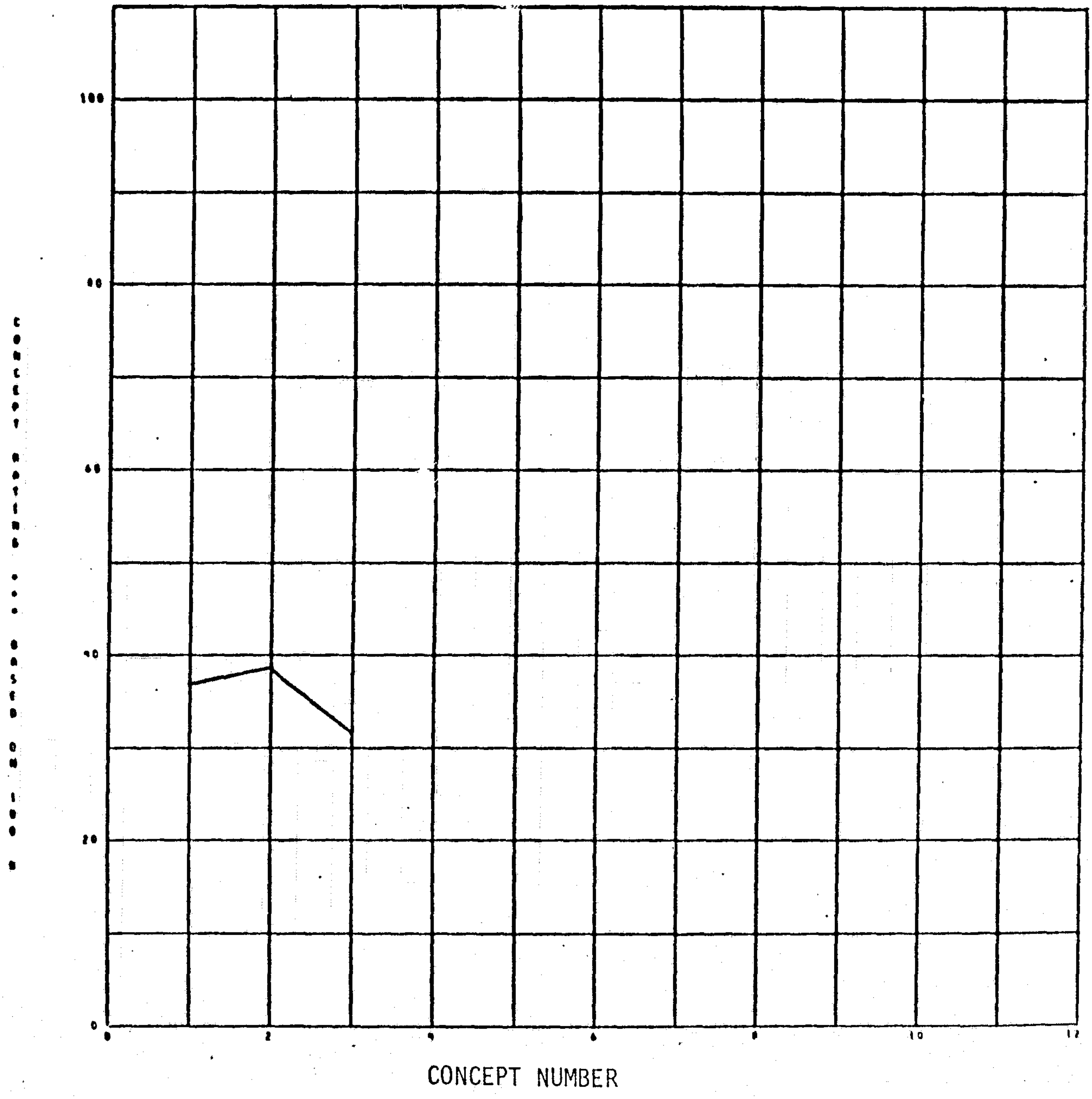


Figure 5-28. Autoclaves (Shuttle) Concept Trade

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	RIGID
2 -	FLEXIBLE

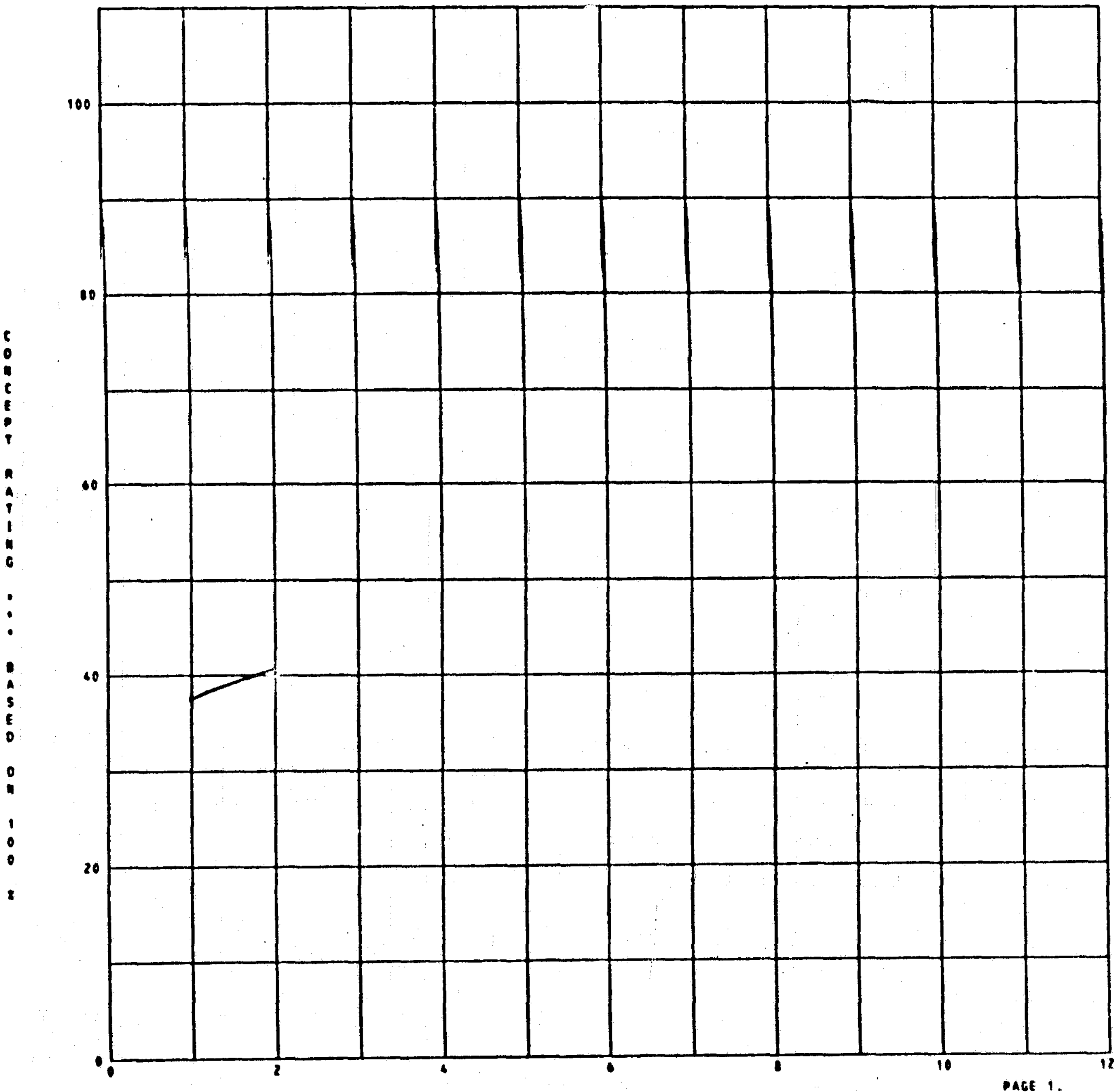


Figure 5-29. Ambient Food Storage (Space Station) Concept Trade

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	-	SPACE RADIATOR
2	-	THERMOELECTRIC
3	-	AIR CYCLE-TURBINE/COMPRESSOR

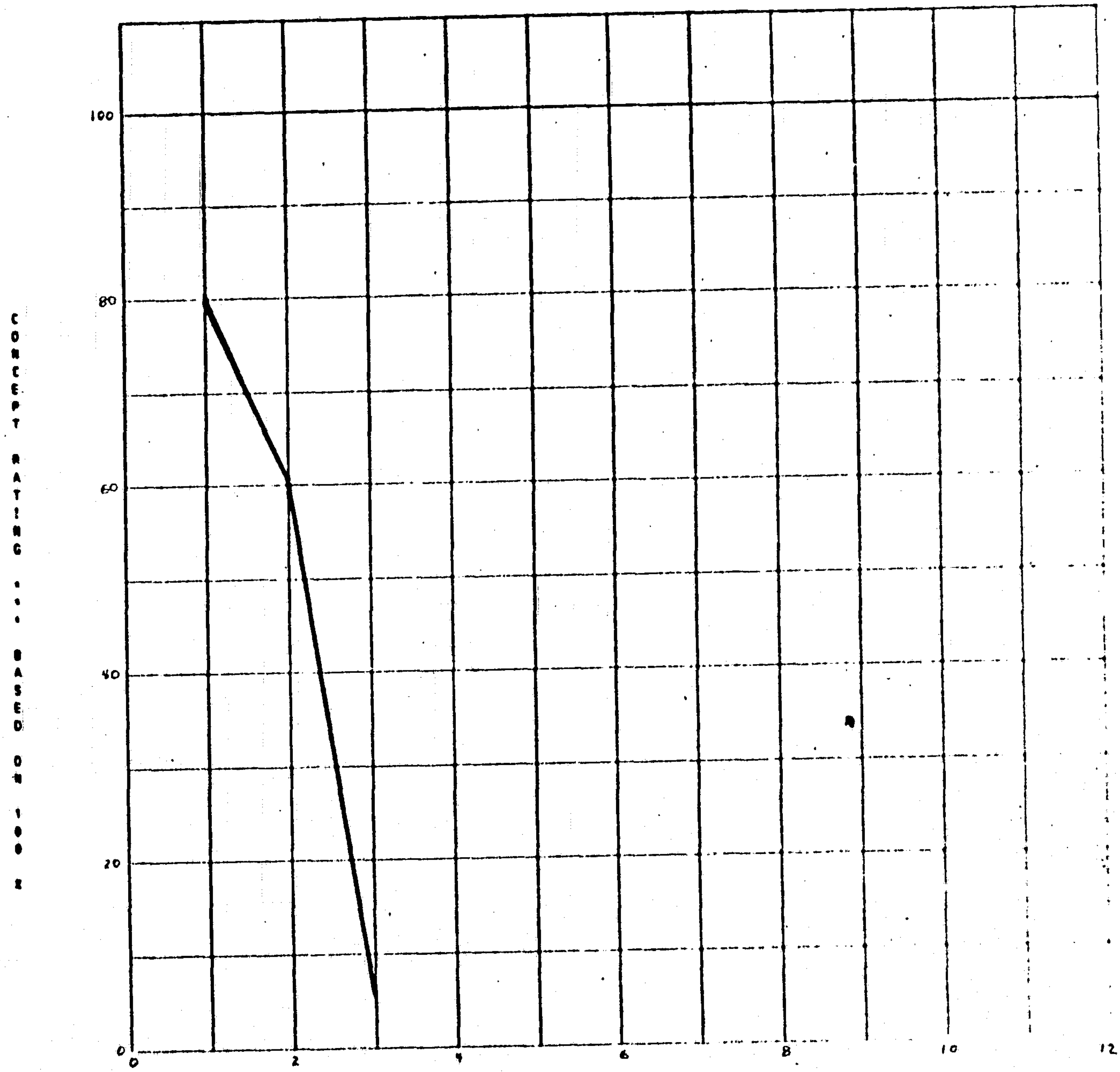


Figure 5-30. Refrigerated Food Storage (Space Station) Concept Trade

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	=	SPACE RADIATOR
2	=	THERMOELECTRIC
3	=	AIR CYCLE

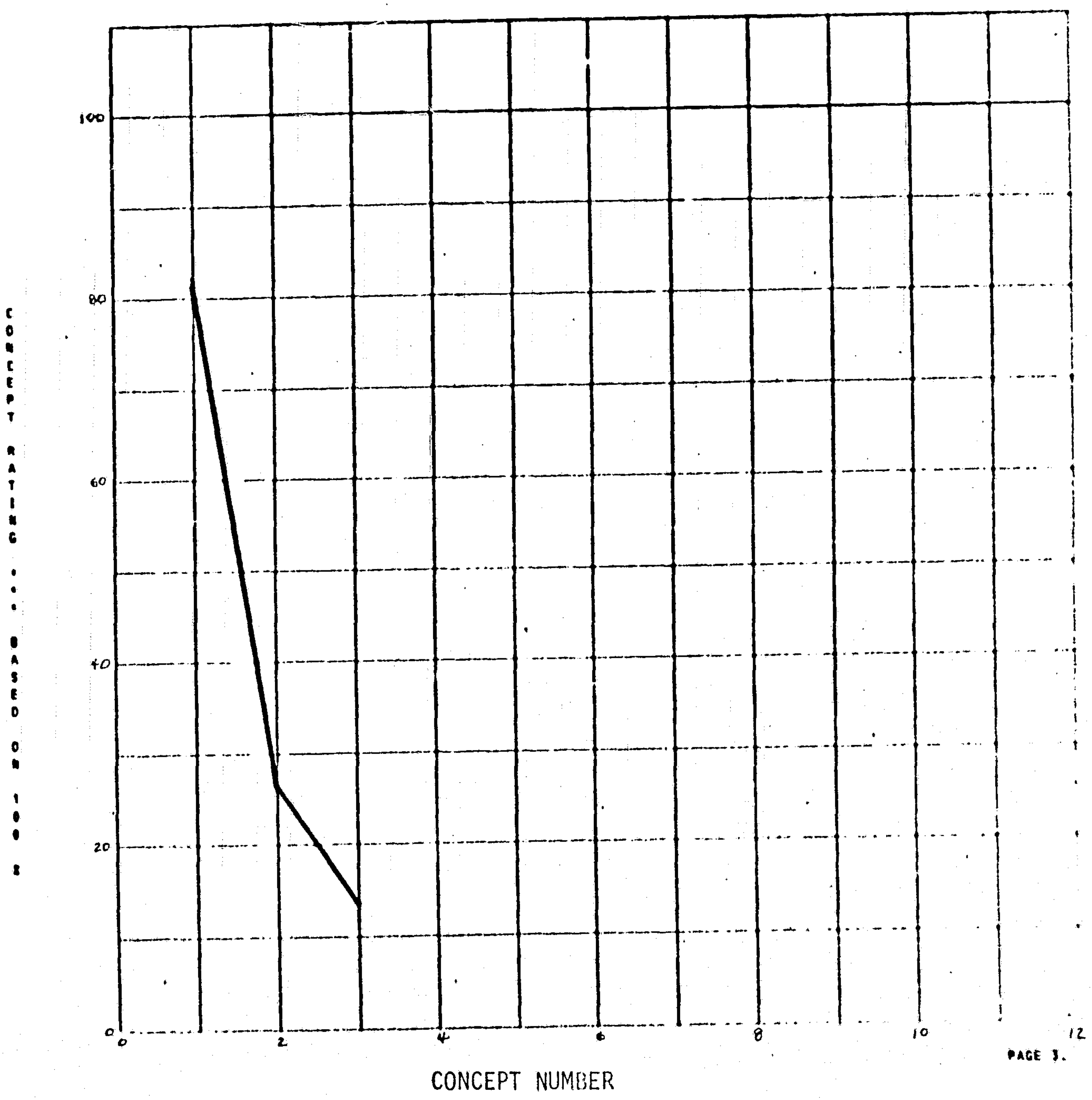


Figure 5-31. Frozen Food Storage (Space Station) Concept Trade

APPLIANCE
CONCEPT
NO. CONCEPT NAME

1 - HEATING TRAYS (SKYLAB)
2 - OVEN-HOT AIR CONVECTION (ELECTRICAL HEAT)
3 - OVEN-MICROWAVE (PLAIN)

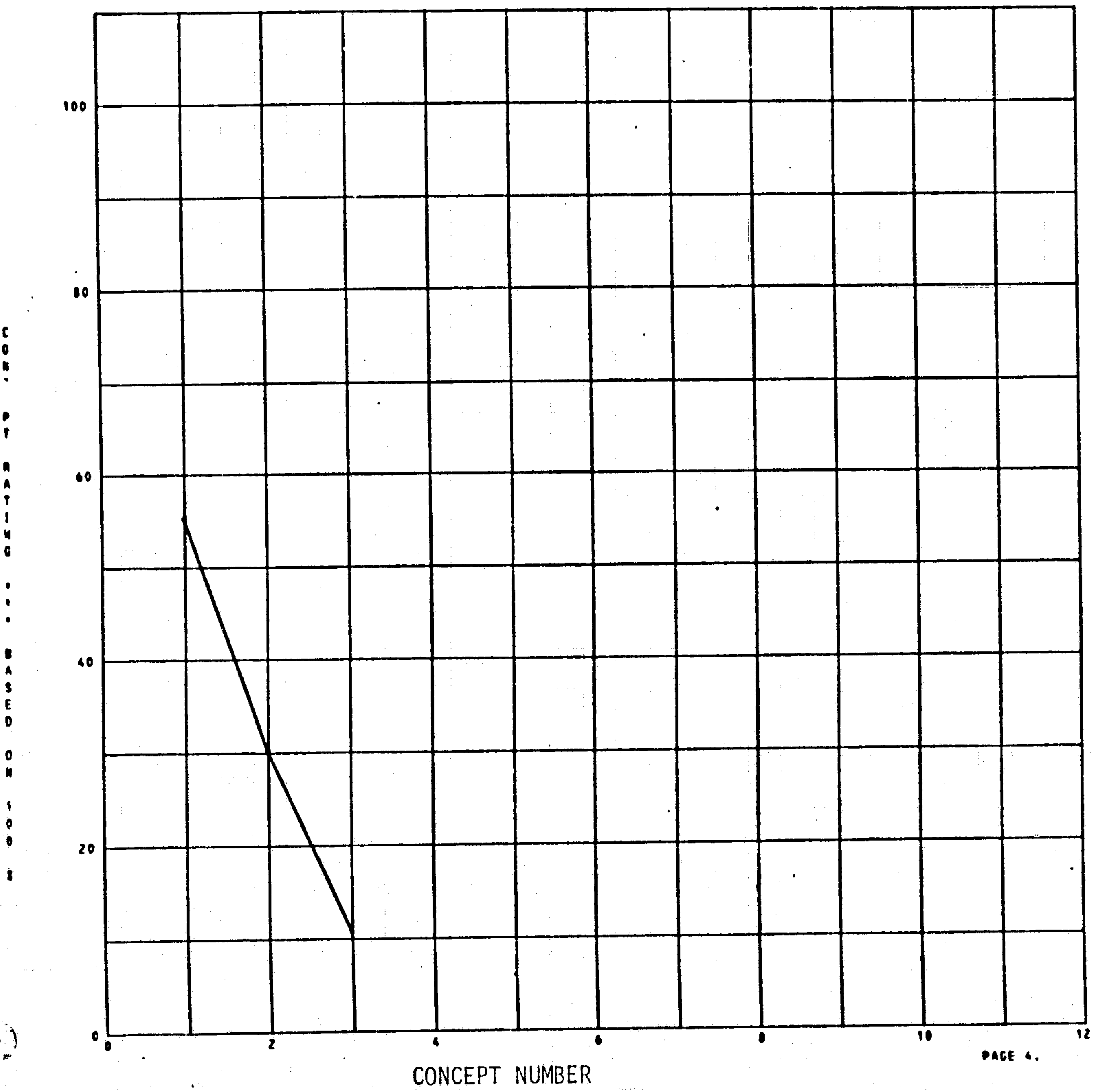


Figure 5-32. Food Warming (Space Station) Concept Trade

APPLIANCE
CONCEPT
NO. CONCEPT NAME

1 - HOT WATER SPRAY-CENTRIFUGE DRYING
2 - HOT WATER SPRAY-AIR SPRAY DRY
3 - HOT WATER SPRAY-FORCED HOT AIRELECTIICHEAT DRY
4 - HOT WATER SPRAY-DESICCANT ELECTRICALLY DESORBED
5 - HOT WATER SPRAY-FORCED HOT AIR DRY-THERMAL STORAGE
6 - ULTRASONIC WASH-CENTRIFUGE DRYING
7 - ULTRASONIC WASH-FORCRD HOT AIR DRYING
8 - ULTRASONIC WASH-FORCED COLD DRY AIR-DESICCANT,ELECTRICALLY DESORBED
9 - ULTRASONIC WASH-FORCED HOT AIR DRY-THERMAL STORAGE
10 - MANUAL WASH-MANUAL WIPE DRY

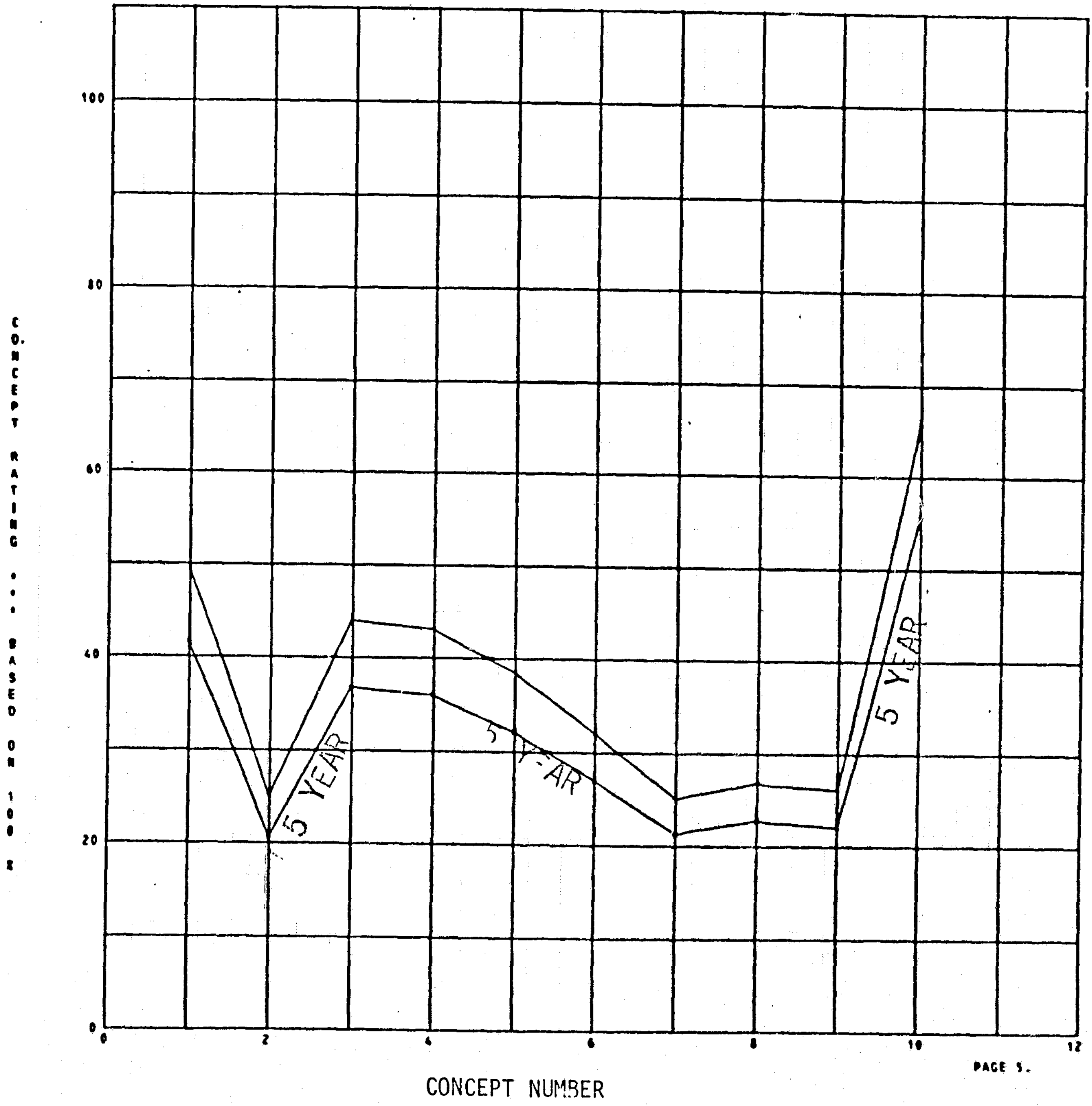


Figure 5-33. Dishwasher/Dryer Combination (Space Station) Concept Trade

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	-	HOT WATER SPRAY-CENTRIFUGE DRYING
2	-	HOT WATER SPRAY-FORCED HOT AIR ELECTRIC HEAT DRYING
3	-	HOT WATER SPRAY-FORCED AIR/DISICCANT/ELECTRICALLY HEATED
4	-	MANUAL WASH-MANUAL WIPE
5	-	DISPOSABLE CUPS-REUSABLE METALLIC UTENSILS AND DISHES
6	-	DISPOSABLE CUPS AND NONMETALLIC DISHES-REUSABLE METALLIC UTENSILS
7	-	DISPOSABLE CUPS AND NONMETALLIC UTENSILS-REUSABLE METALLIC DISHES
8	-	DISPOSABLE CUPS AND NONMETALLIC UTENSILS AND DISHES
9	-	REUSABLE CUPS AND METALLIC UTENSILS AND DISHES
10	-	REUSABLE CUPS AND METALLIC UTENSILS+DISPOSABLE NONMETALLIC DISHES
11	-	REUSABLE CUPS AND METALLIC DISHES--DISPOSABLE NONMETALLIC UTENSILS
12	-	REUSABLE CUPS-DISPOSABLE NONMETALLIC UTENSILS AND DISHES

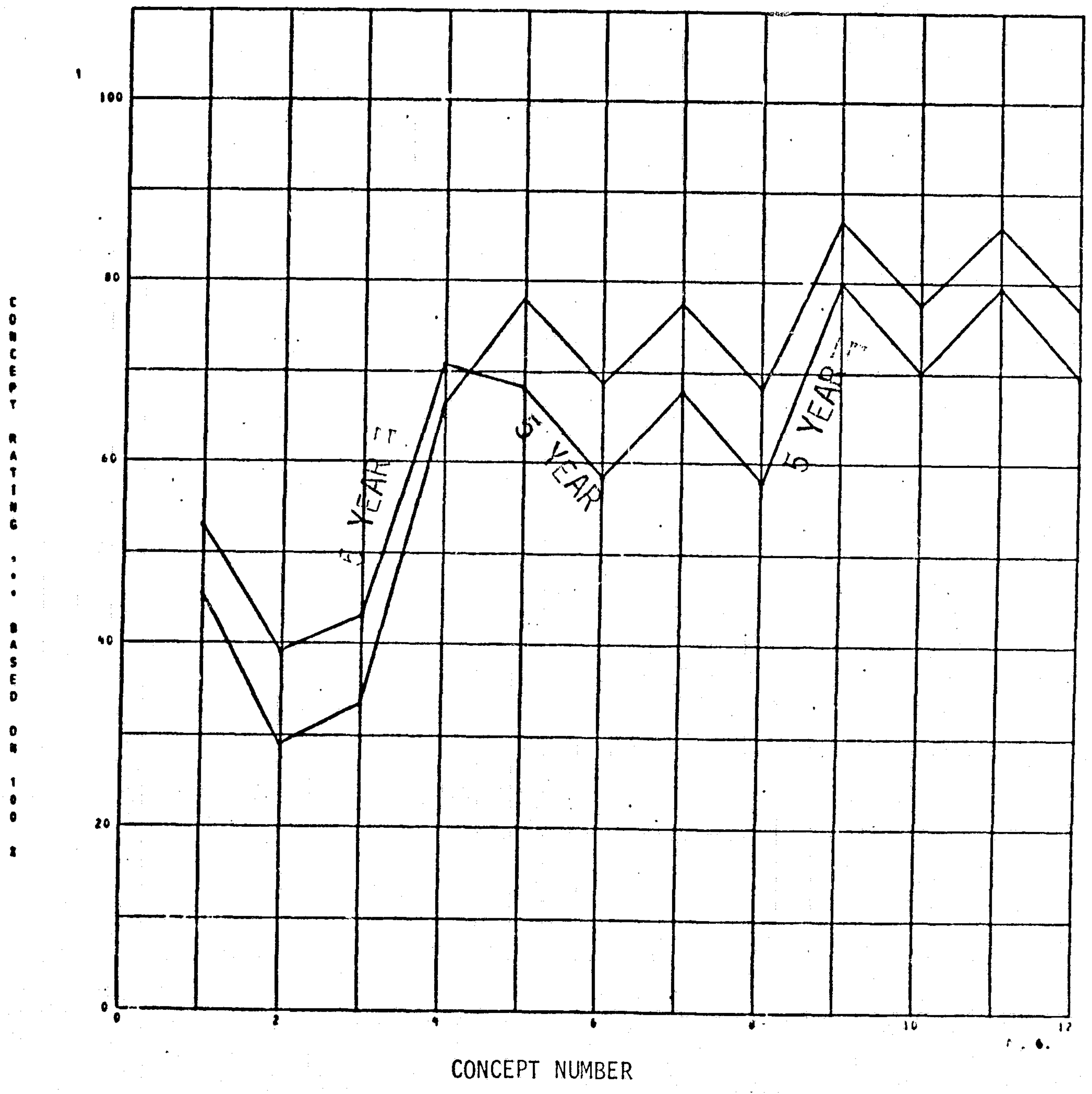


Figure 5-34. Dishwasher/Dryer with Dishes (Space Station) Concept Trade

APPLIANCE CONCEPT NO. CONCEPT NAME

1 - DRY JOHN
2 - DRY JOHN-ANAL WASH
3 - GERMICIDE
4 - INTEGRATED VACUUM DECOMPOSITION
5 - FLUSH FLOW OXYGEN INCINERATION
6 - PYROLYSIS/BATCH INCINERATION
7 - WET OXIDIZATION
8 - SEMIAUTOMATIC BAG SYSTEM (SKYLAB)
9 - DRY BAGS (APOLLO)

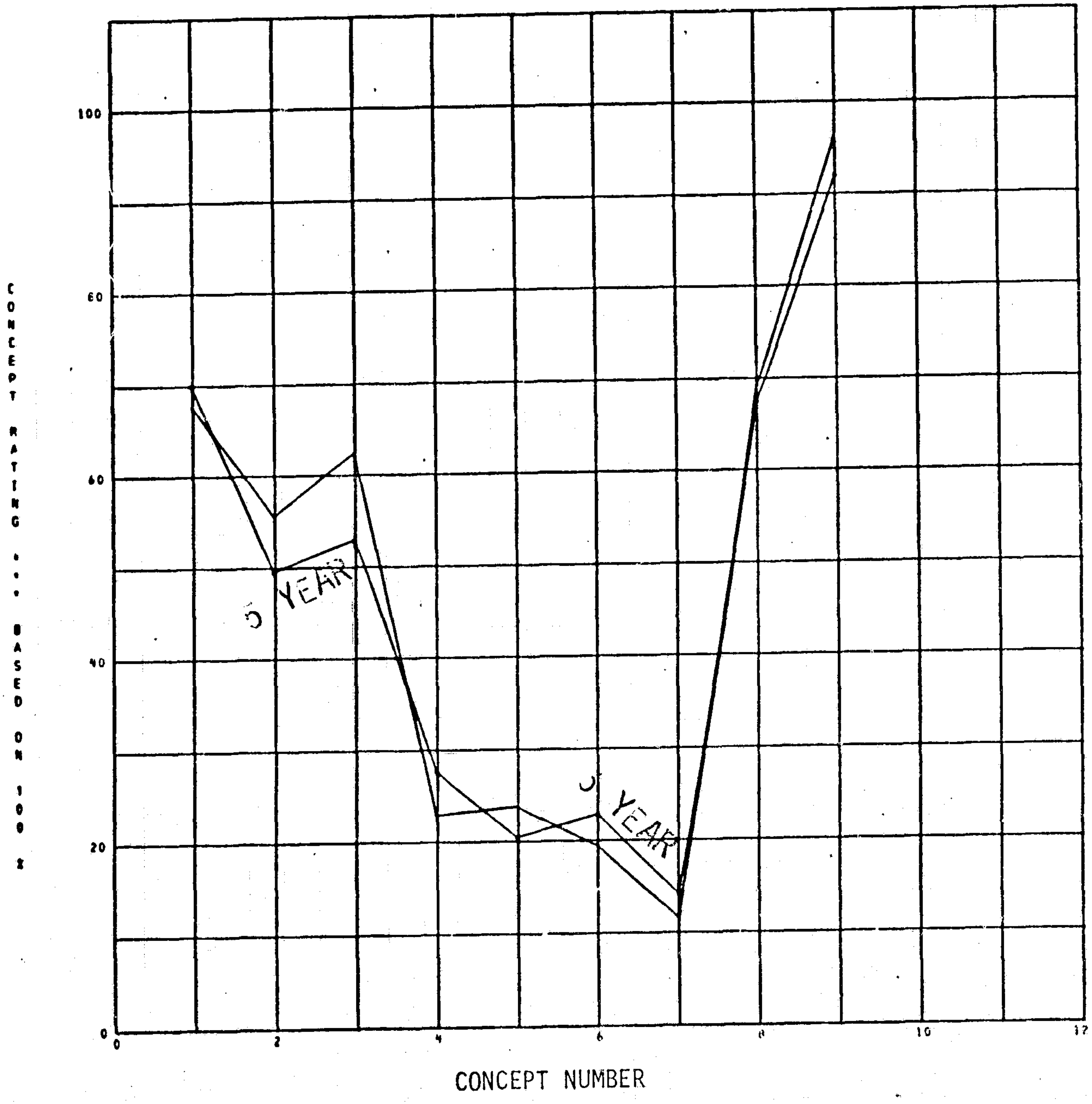
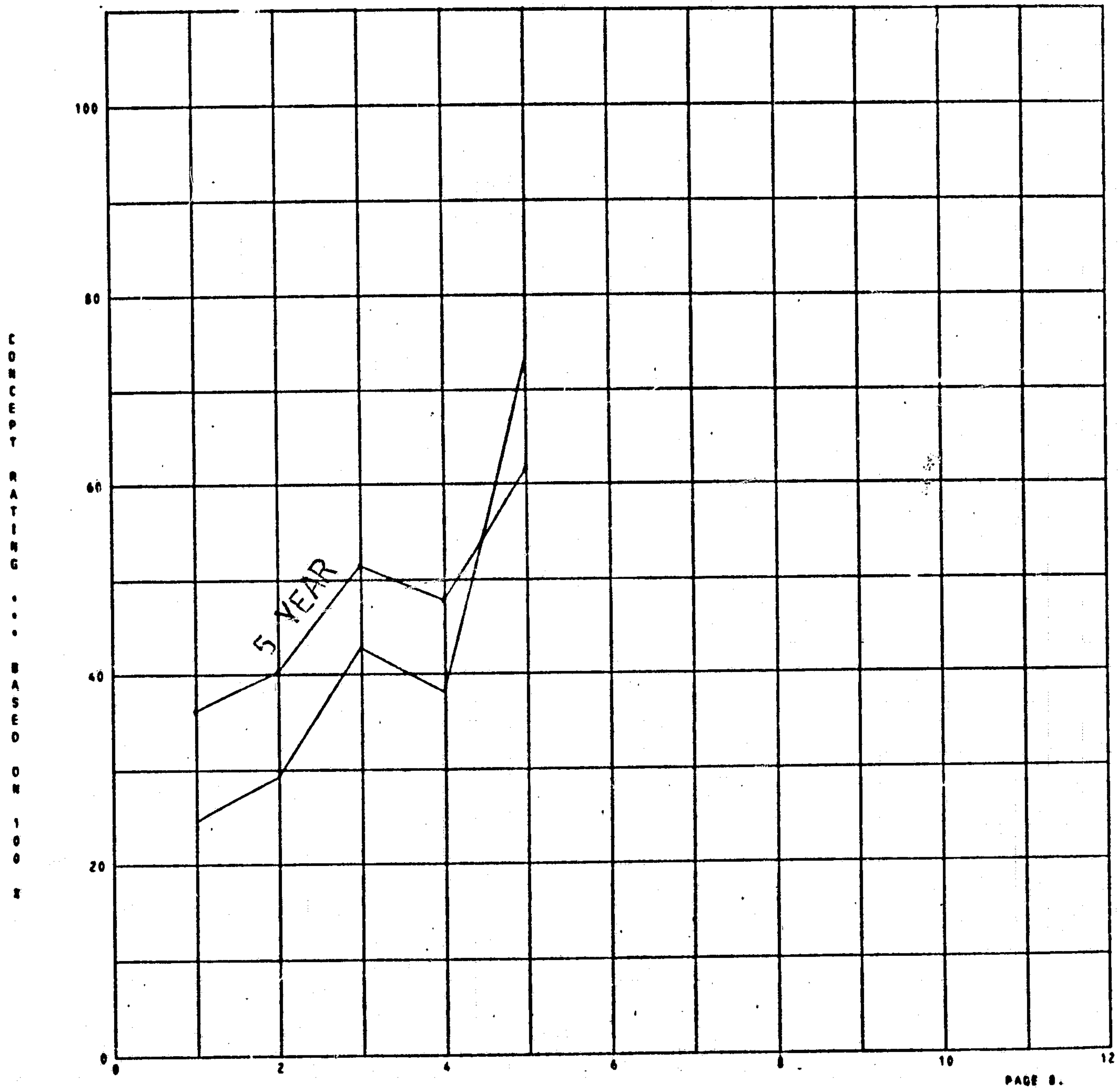


Figure 5-35. Fecal Collection/Transfer (Space Station) Concept Trade

APPLIANCE
CONCEPT
NO. CONCEPT NAME

1 - STANDUP URINAL
2 - COMMODE URINAL
3 - INTIMATE MALE ADAPTER (SKYLAB)
4 - APERTURE URINAL
5 - LIQUID/GAS FLOW CUFF TYPE (APOLLO)



CONCEPT NUMBER

Figure 5-36. Urine Collection/Transfer (Space Station) Concept Trade

APPLIANCE CONCEPT NO. CONCEPT NAME

1 - INTIMATE PERSONAL ADAPTOR, DISPOSABLE (MATES WITH COMMODE)
2 - INTIMATE PERSONAL ADAPTOR, DISPOSABLE (MATES WITH COMMODE)
3 - PORTABLE DISPOSABLE COLLECTOR (TYPE USE COMMERCIALLY)
4 - REUSABLE PORTABLE COLLECTOR

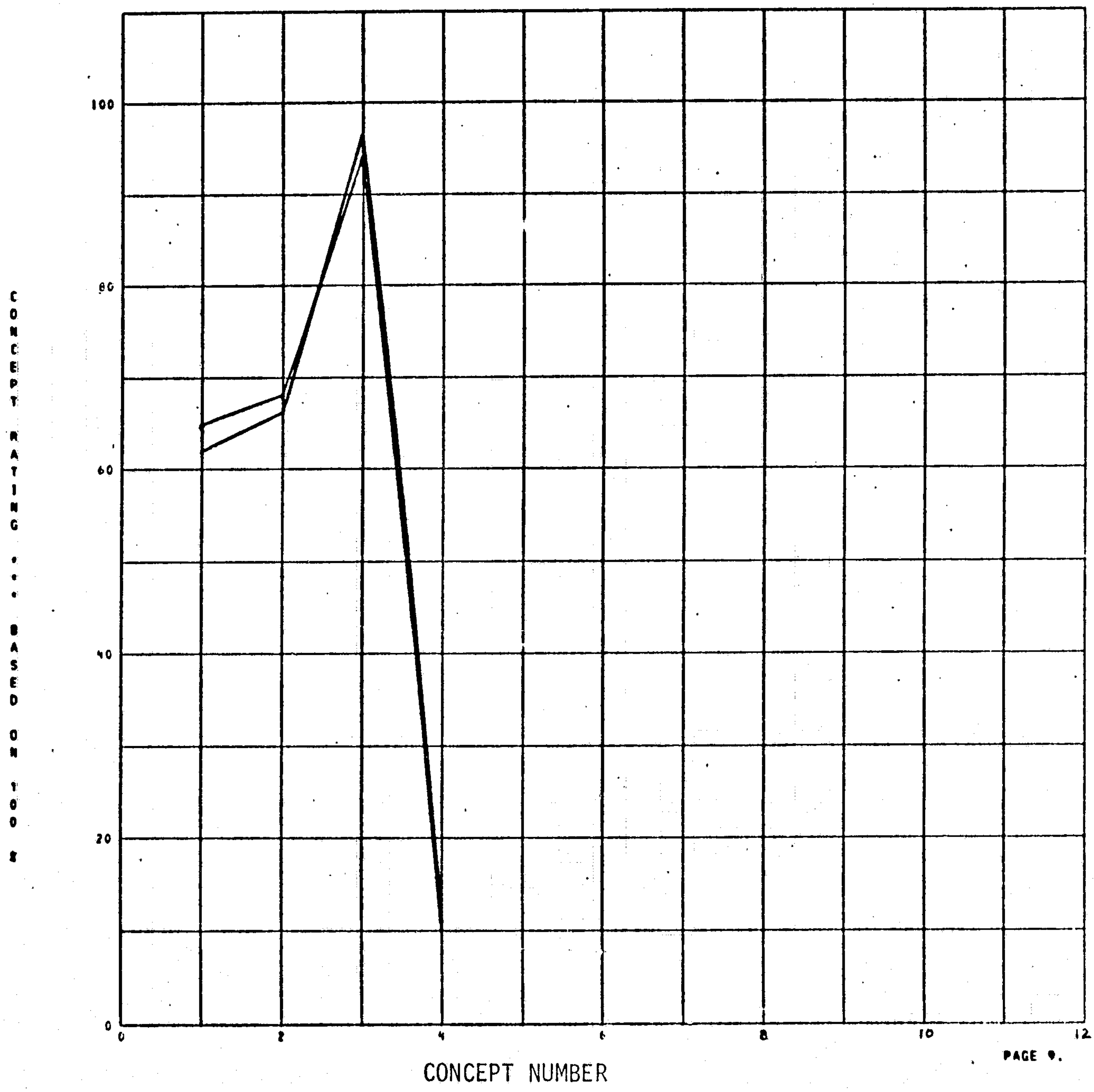


Figure 5-37. Vomitus Collection/Transfer (Space Station) Concept Trade

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	VACUUM PICKUP
2 -	AIR DRAG
3 -	MECHANICAL
4 -	COLLAPSIBLE

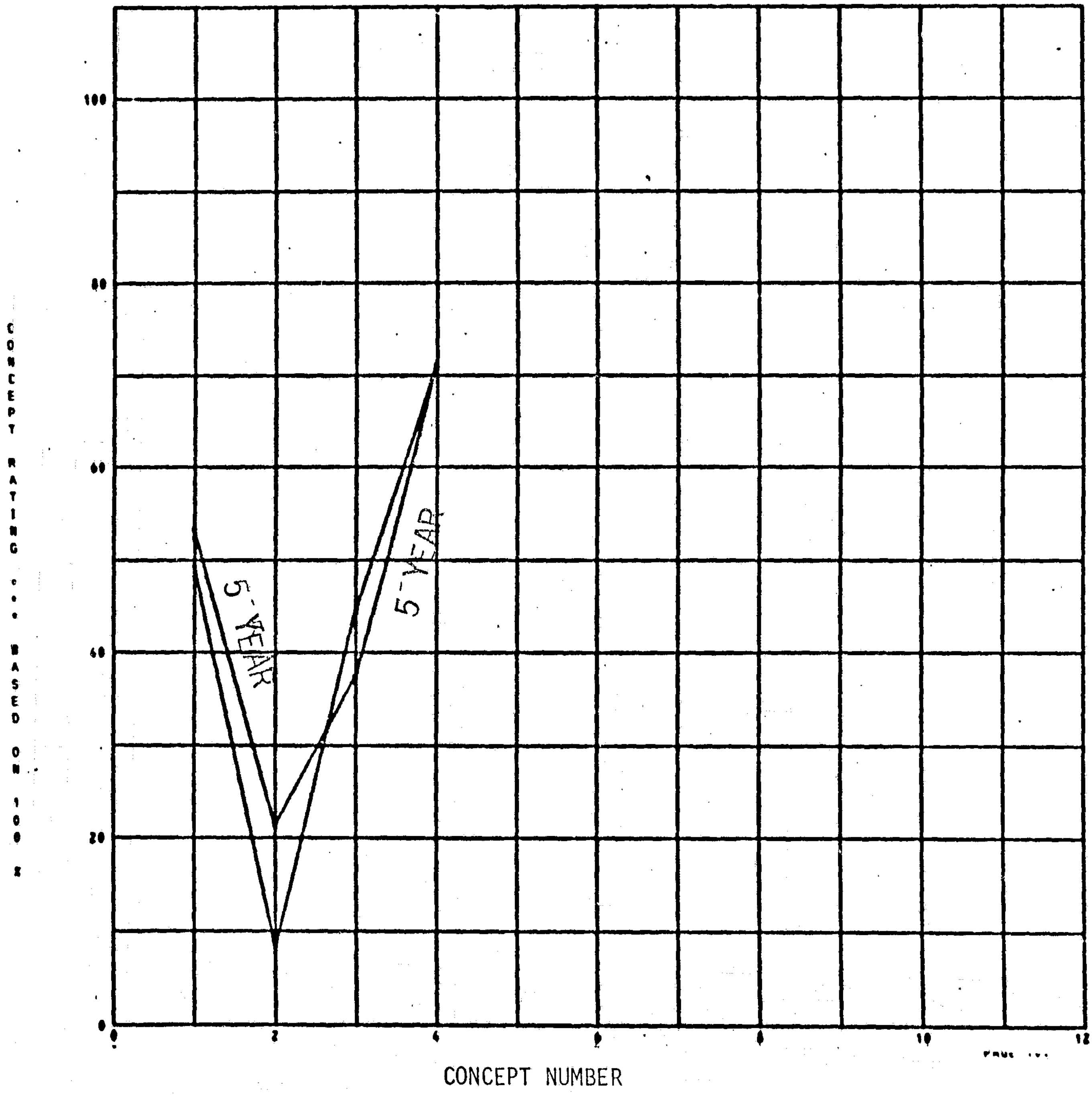


Figure 5-38. Whole Body Shower (Space Station) Concept Trade

APPLIANCE
CONCEPT
NO. CONCEPT NAME

1 - DISPOSABLE WET WIPES
2 - REUSABLE WET WIPES
3 - DISPOSABLE WIPES (PREPACKAGED)
4 - AUTOMATIC SPONGE
5 - REUSABLE WASHCLOTHES
6 - DISPOSABLE WASHCLOTHES (SKYLAB)

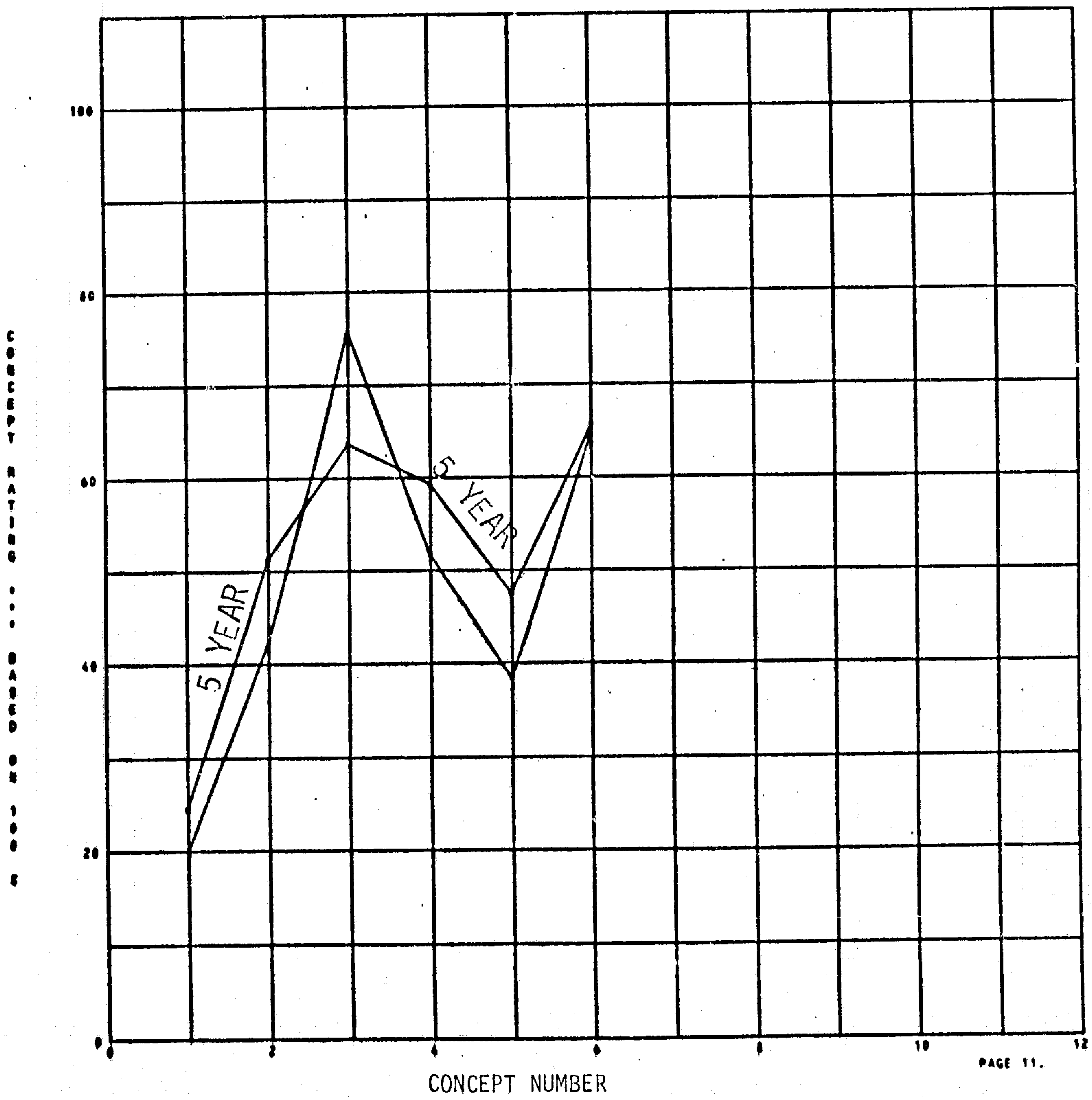


Figure 5-39. Partial Body Washing (Space Station) Concept Trade

APPLIANCE CONCEPT NO. — CONCEPT NAME

1 - REUSABLE DRY WIPES
2 - DISPOSABLE DRY WIPES
3 - ELECTRIC DRYER

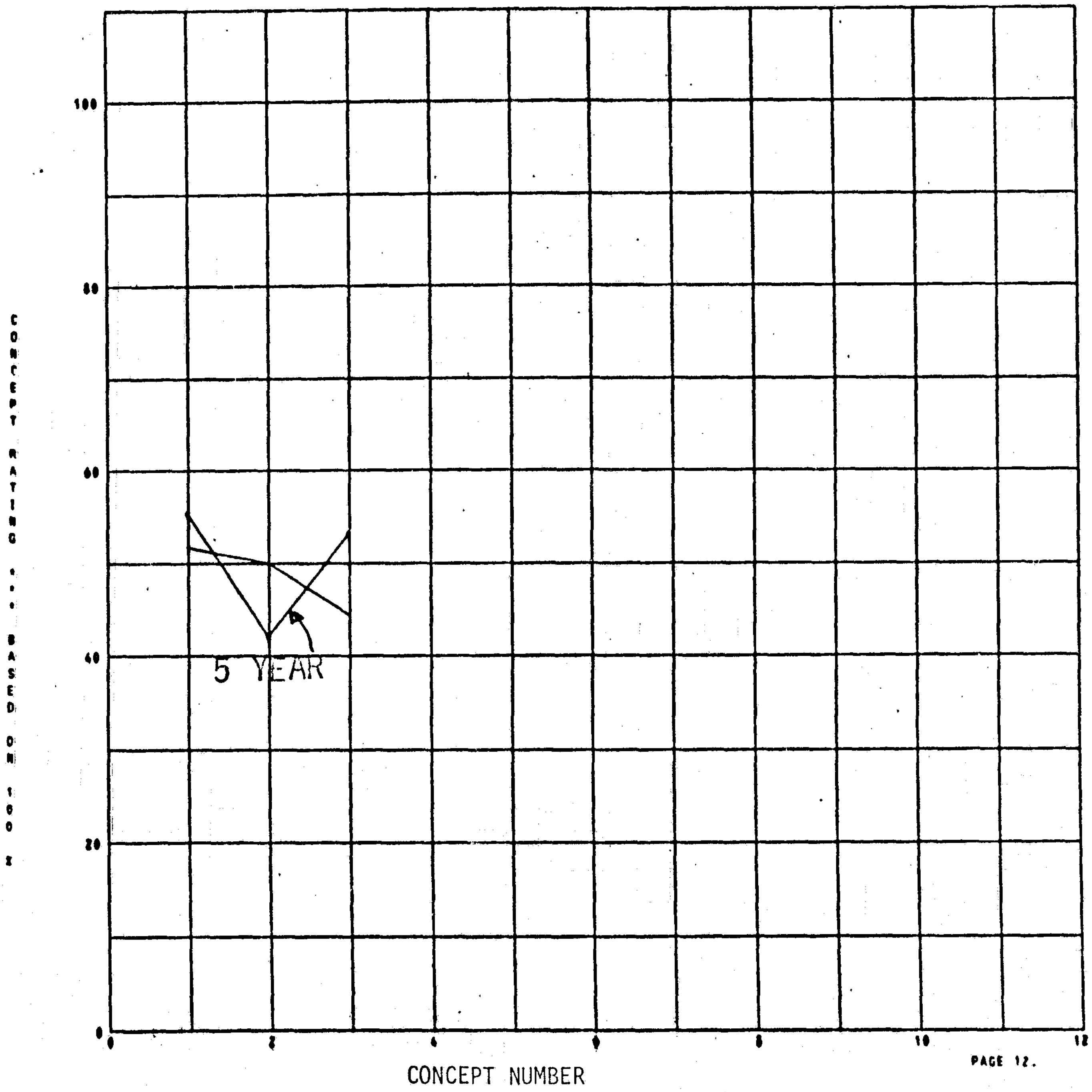


Figure 5-40. Partial Body Drying (Space Station) Concept Trade

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	-	WET SHAVE WITH SAFETY RAZOR AND CREAM
2	-	DRY SHAVE-ELECTRIC RAZOR/VACUUM COLLECTION
3	-	DRY SHAVE-WINDUP RAZOR
4	-	DRY SHAVE-VACUUM DRIVEN RAZOR
5	-	WET SHAVE-SAFETY RAZOR/VACUUM

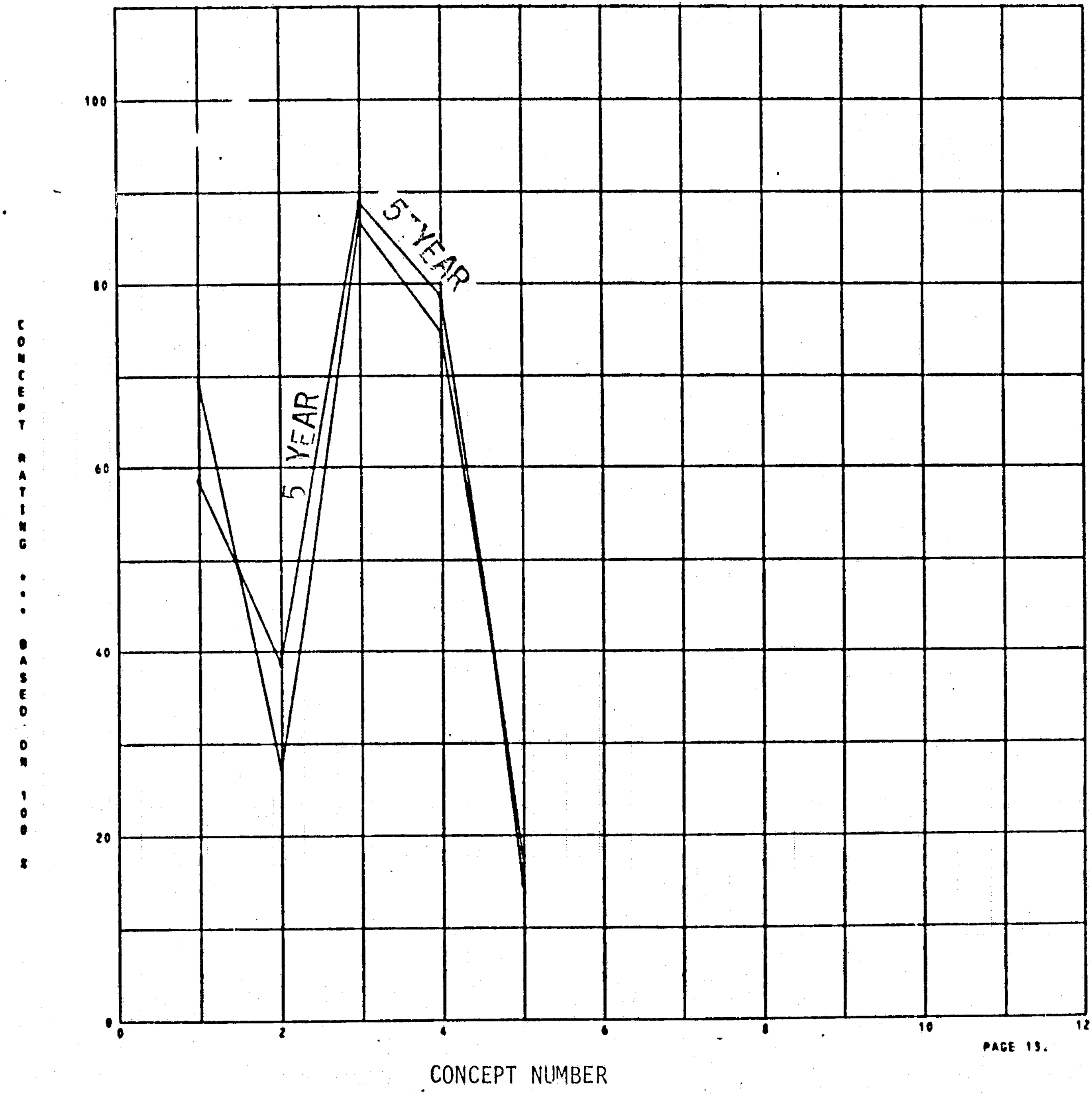


Figure 5-41. Shaving (Space Station) Concept Trade

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	POWER CLIPPER/VACUUM COLLECTION
2 -	RAZOR COMB/VACUUM COLLECTION

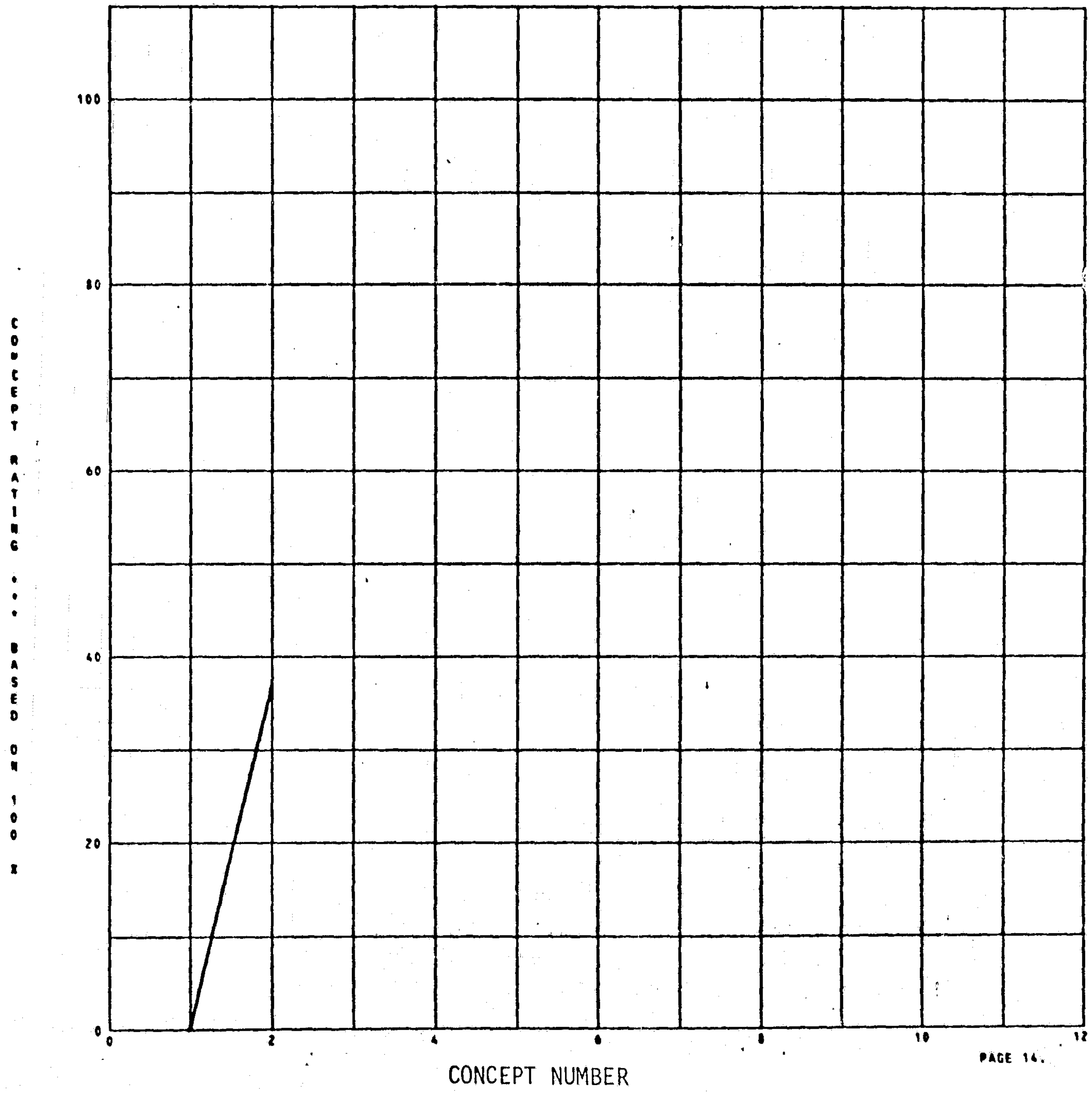


Figure 5-42. Hair Cutting (Space Station) Concept Trade

APPLIANCE
CONCEPT
NO. CONCEPT NAME

1 - MANUAL NAIL CLIPPER
2 - METAL NAIL FILE-VACUUM COLLECTION

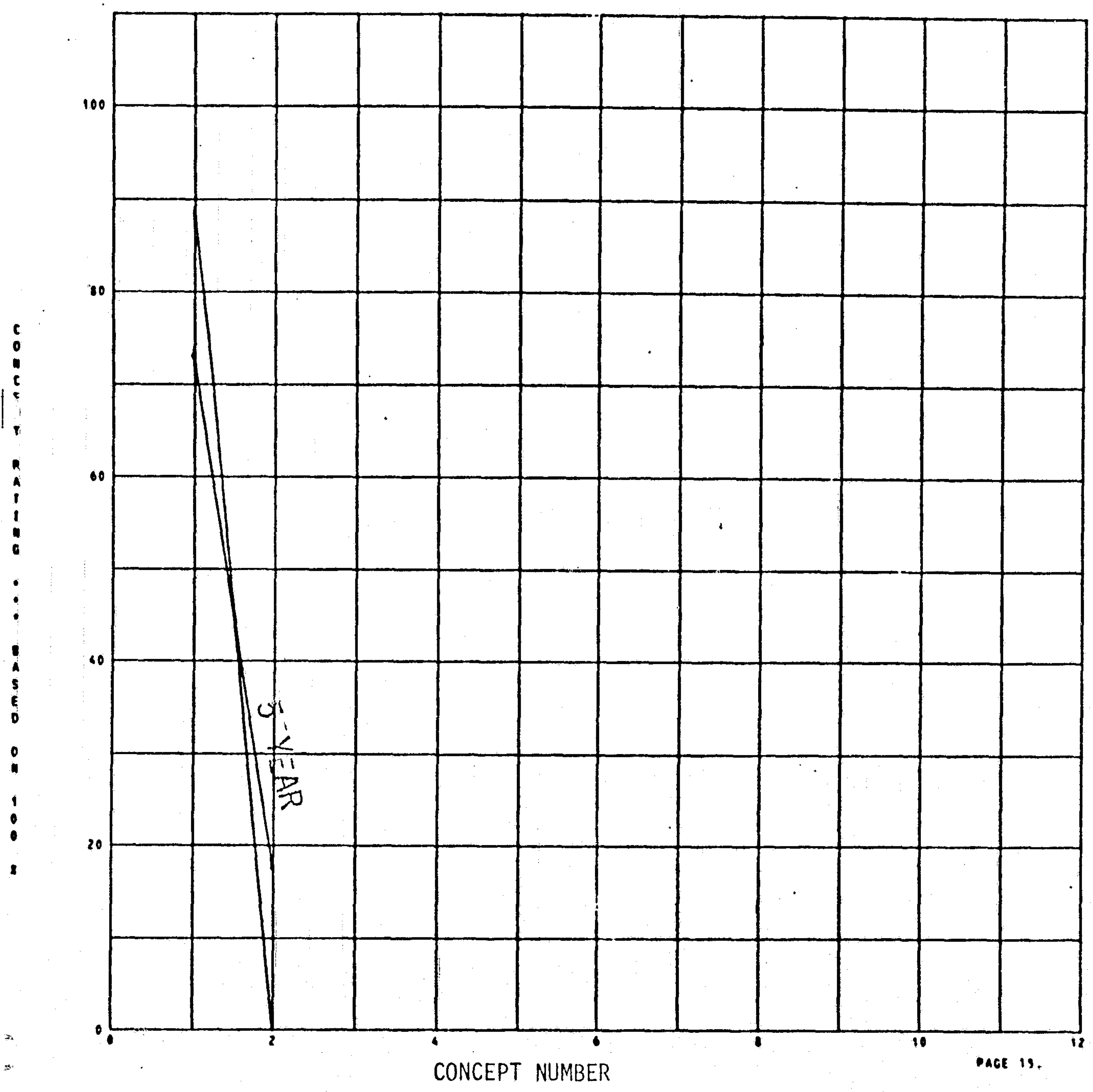


Figure 5-43. Nail Care (Space Station) Concept Trade

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	TOOTHPASTE WITH DENTIFRICE
2 -	WATER PIX
3 -	ELECTRIC TOOTHBRUSH

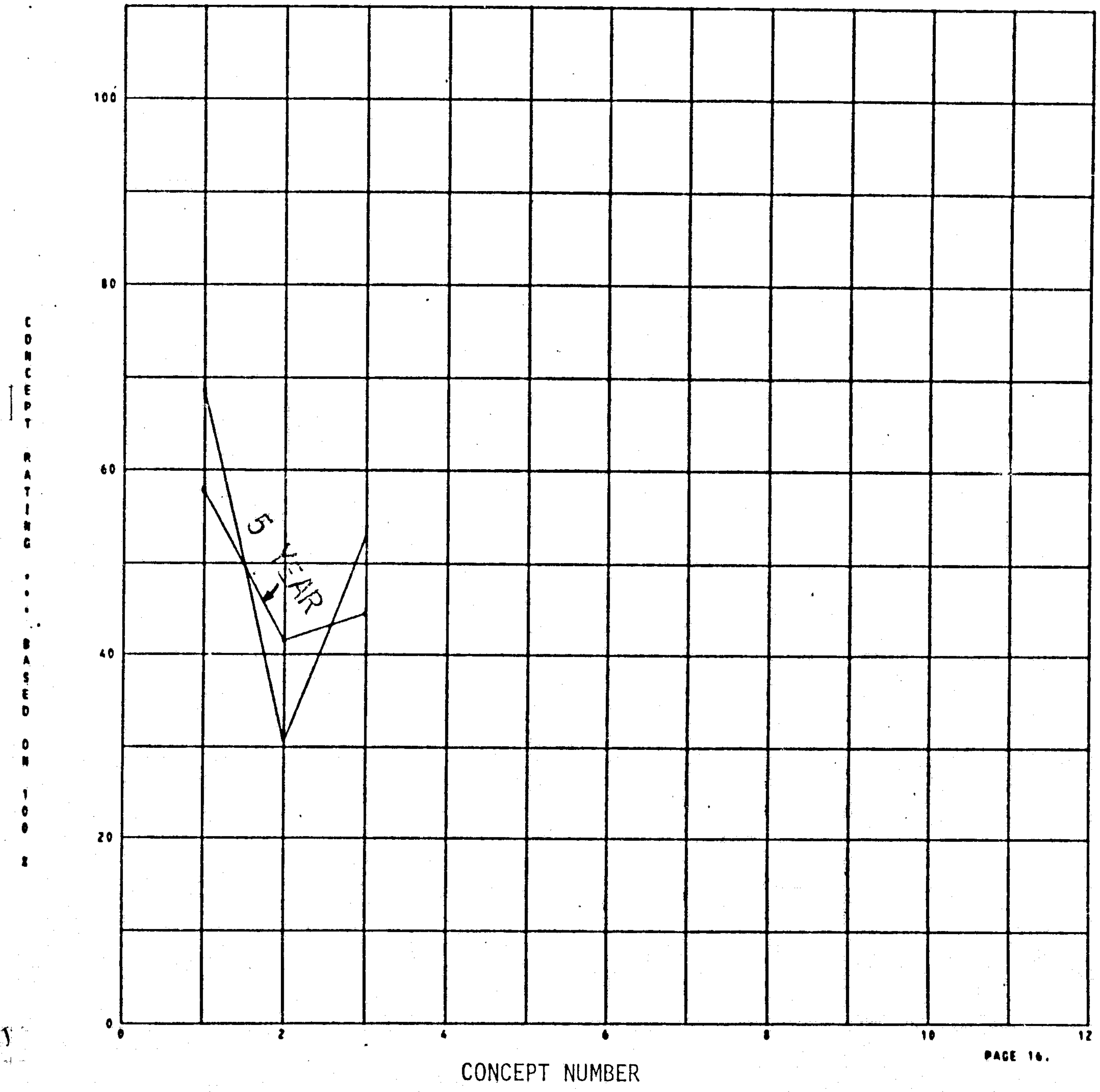


Figure 5-44. Dental (Space Station) Concept Trade

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	DISPOSABLE WET/DRY WIPES
2 -	REUSABLE WET WIPES-DISPOSABLE DRY WIPES
3 -	DISPOSABLE WET/DRY WIPES (PREPACKAGED)
4 -	AUTOMATIC SPONGE MOP
5 -	REUSABLE CLEANING CLOTHS DISPOSABLE DRY WIPES
6 -	DISPOSABLE CLEANING CLOTHS (SKLAB) DISPOSABLE DRY WIPES
7 -	DISPOSABLE WET WIPES REUSABLE DRY WIPES
8 -	REUSABPLE WET/DRY WIPES
9 -	REUSABLE CLEANING CLOTHS/DRY WIPES
10 -	DISPOSABLE CLEANING CLOTHS REUSABLE DRY WIOES
11 -	SPONGES/ENCLOSED WETTING UNIT
12 -	SPONGES/SKYLAB TYPE WETTING UNIT

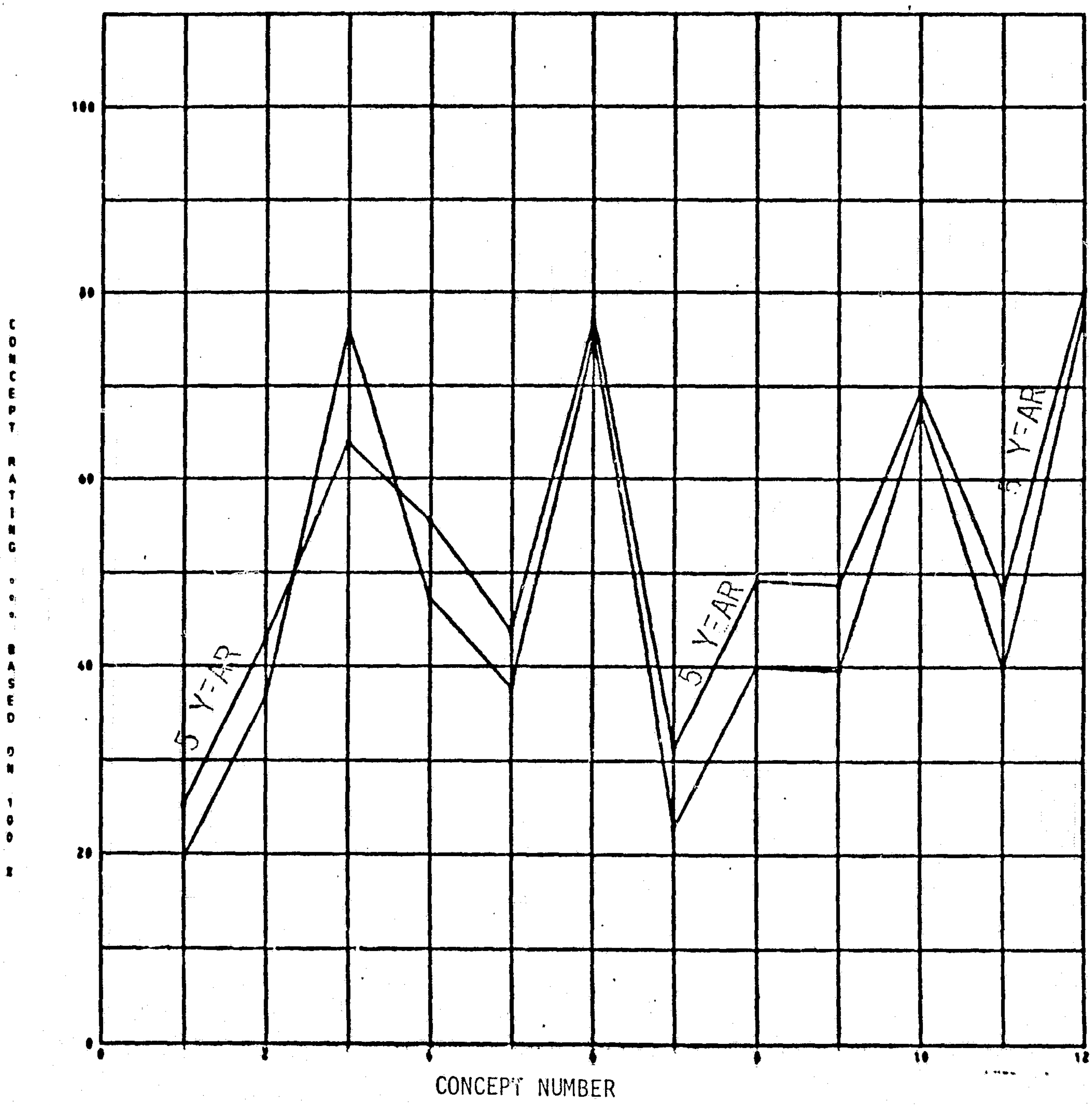


Figure 5-45. Surface Wiping (Space Station) Concept Trade

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	-	DISPOSABLE TRASH BAG
2	-	REUSABLE WASTE RECEPTICLES
3	-	DISPOSABLE WASTE RECEPTICLES

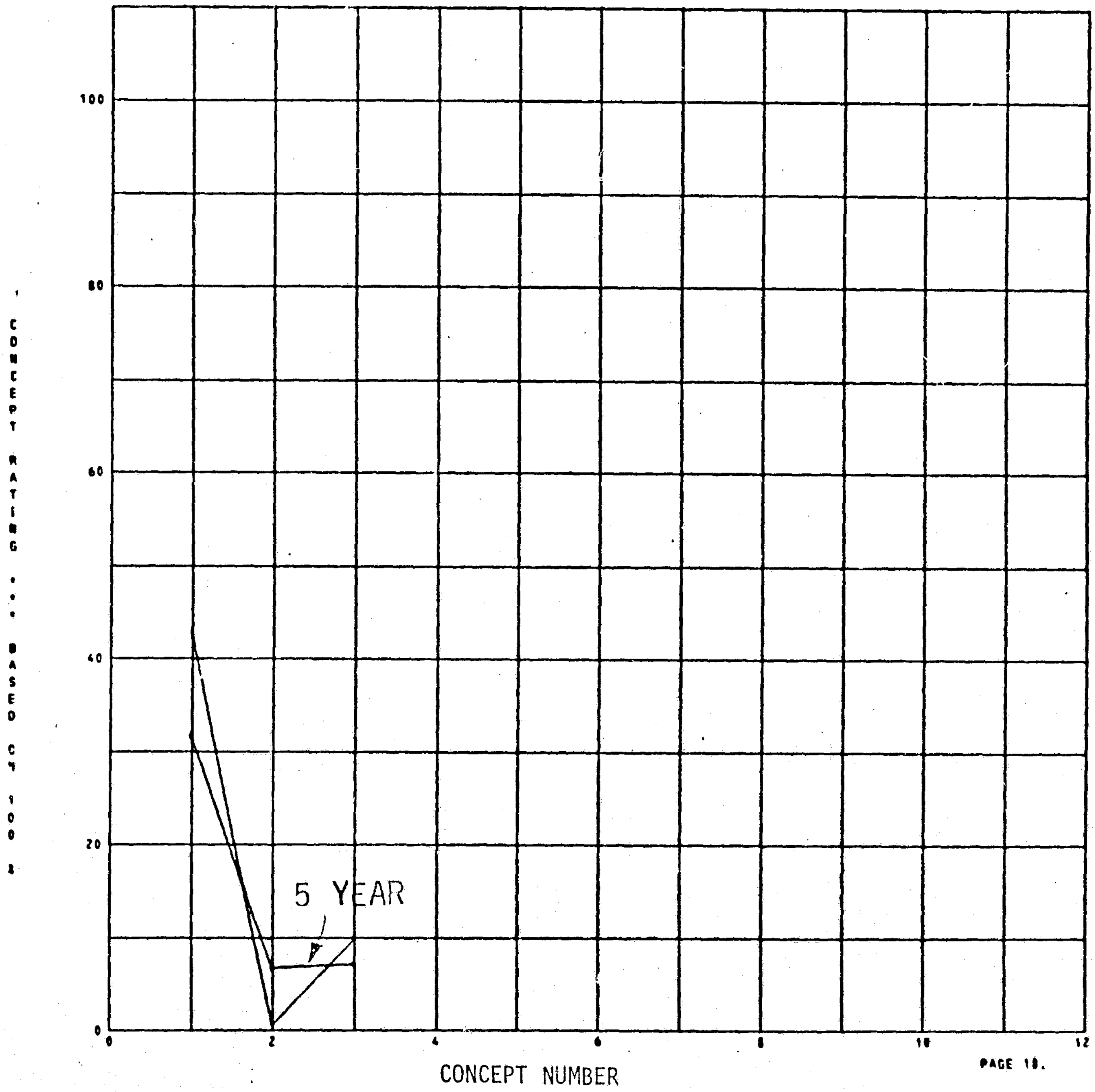


Figure 5-46. Manual Refuse Collection (Space Station) Concept Trade

APPLIANCE CONCEPT NO.	CONCEPT NAME
1 -	VACUUM CLEANER (SKYLAB)
2 -	VACUUM CLEANER (COMMERICAL)
3 -	VACUUM CLEANER-VENTED TO SPACE

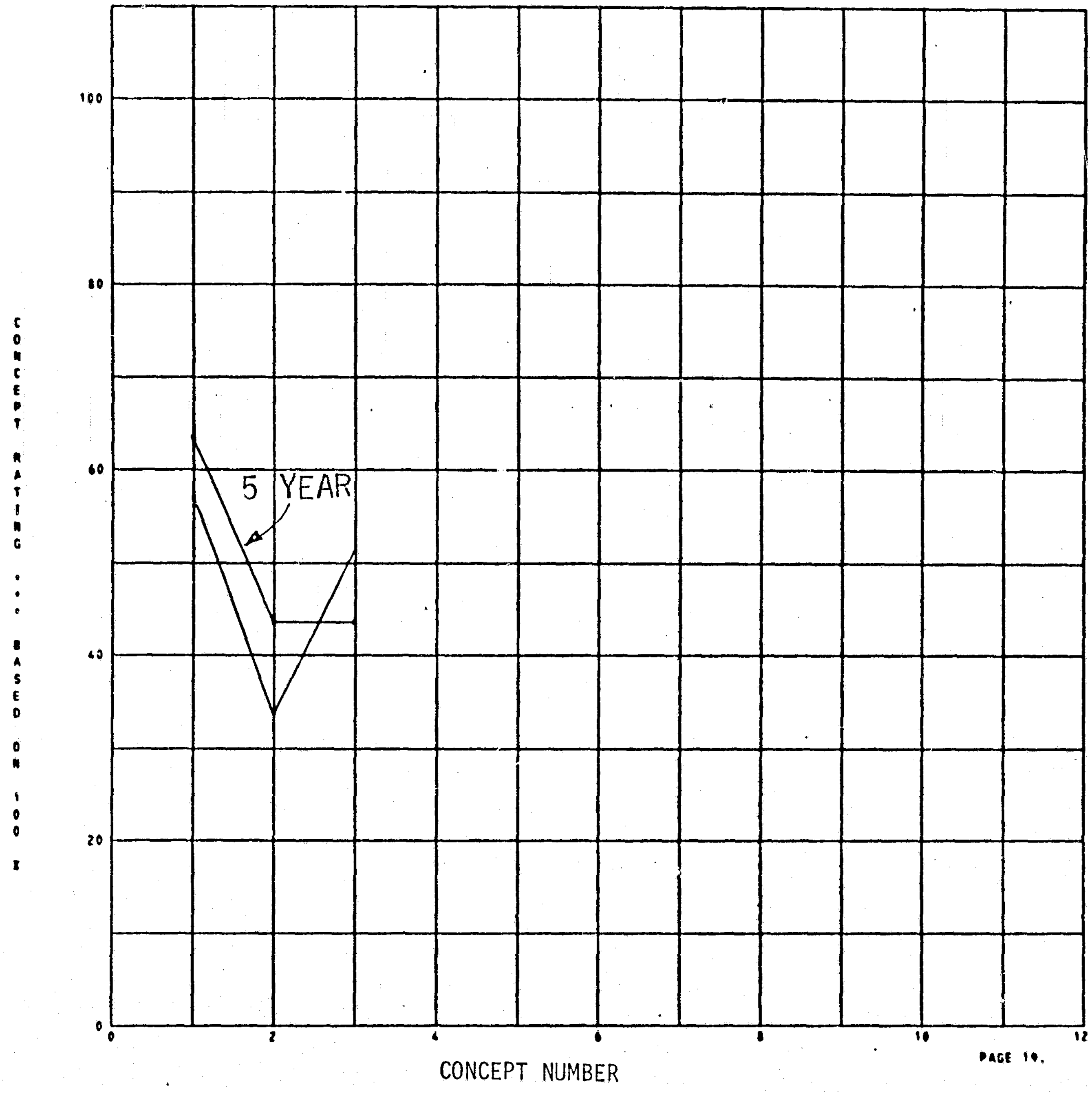


Figure 5-47. Vacuum Refuse Collection (Space Station) Concept Trade

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	-	COMPACTOR-AIR PRESSURE
2	-	COMPACTOR-VACUUM
3	-	COMPACTOR-MOTOR
4	-	COMPACTOR-MANUAL
5	-	COMPACTOR-AIR PRESSURE W/SHREDDER
6	-	COMPACTOR-VACUUM W/SHREDDER
7	-	COMPACTOR-MOTOR W/SHREDDER
8	-	COMPACTOR-MANUAL W/SHREDDER
9	-	INTEGRATED VACUUM DECOMPOSTION/SHREDDER
10	-	FLUSH FLOW OXYGEN INCINERATION/SHREDDER
11	-	PYROLYSIS/BATCH INCINERATION/SHREDDER
12	-	WET OXIDIZATION/ SHREDDER

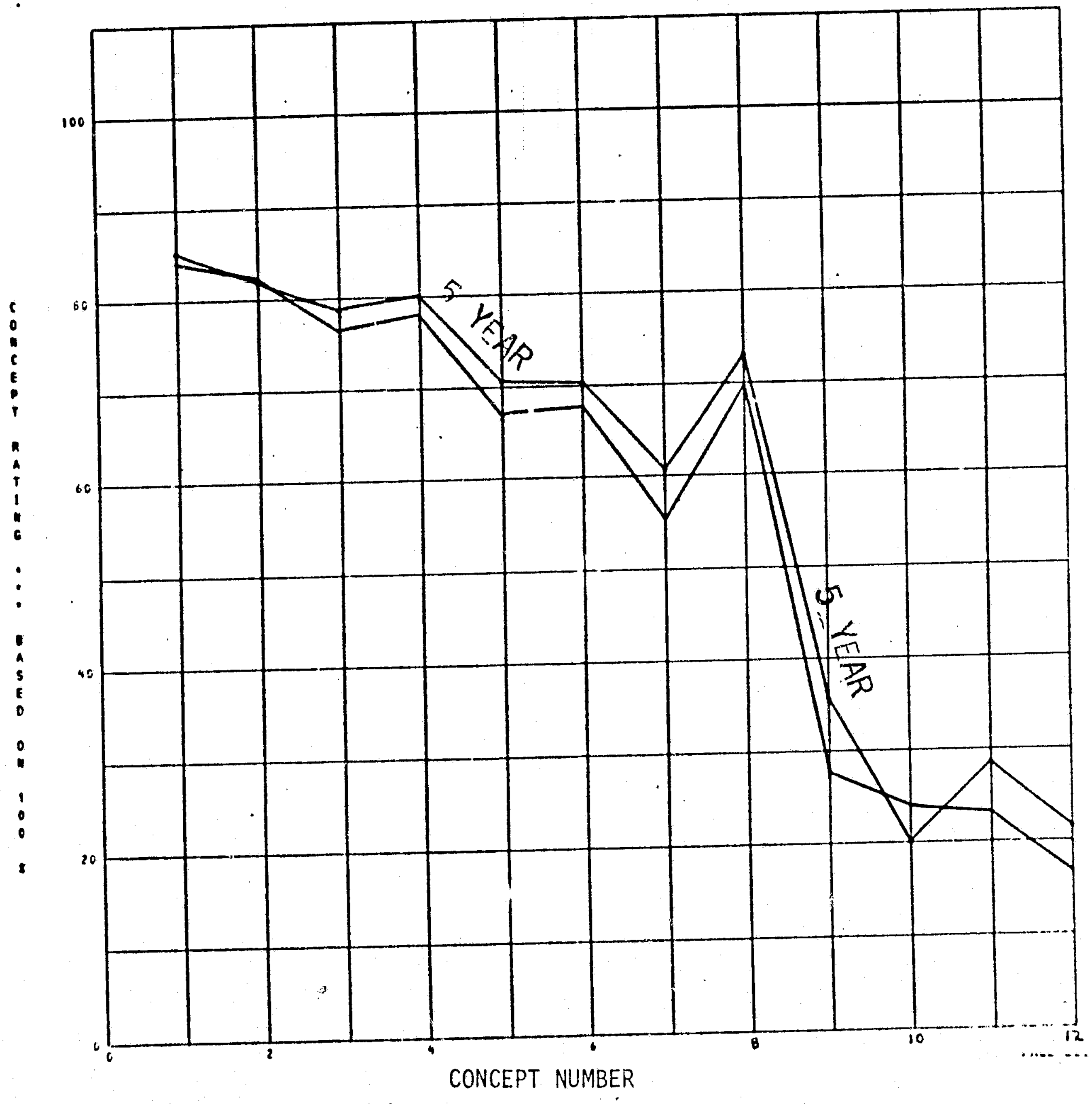


Figure 5-48. Refuse Processing (Space Station) Concept Trade

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	-	VACUUM STORAGE
2	-	STORAGE BIN/CONTAINER
3	-	SOLID PROPELLANT REFUSE ROCKET

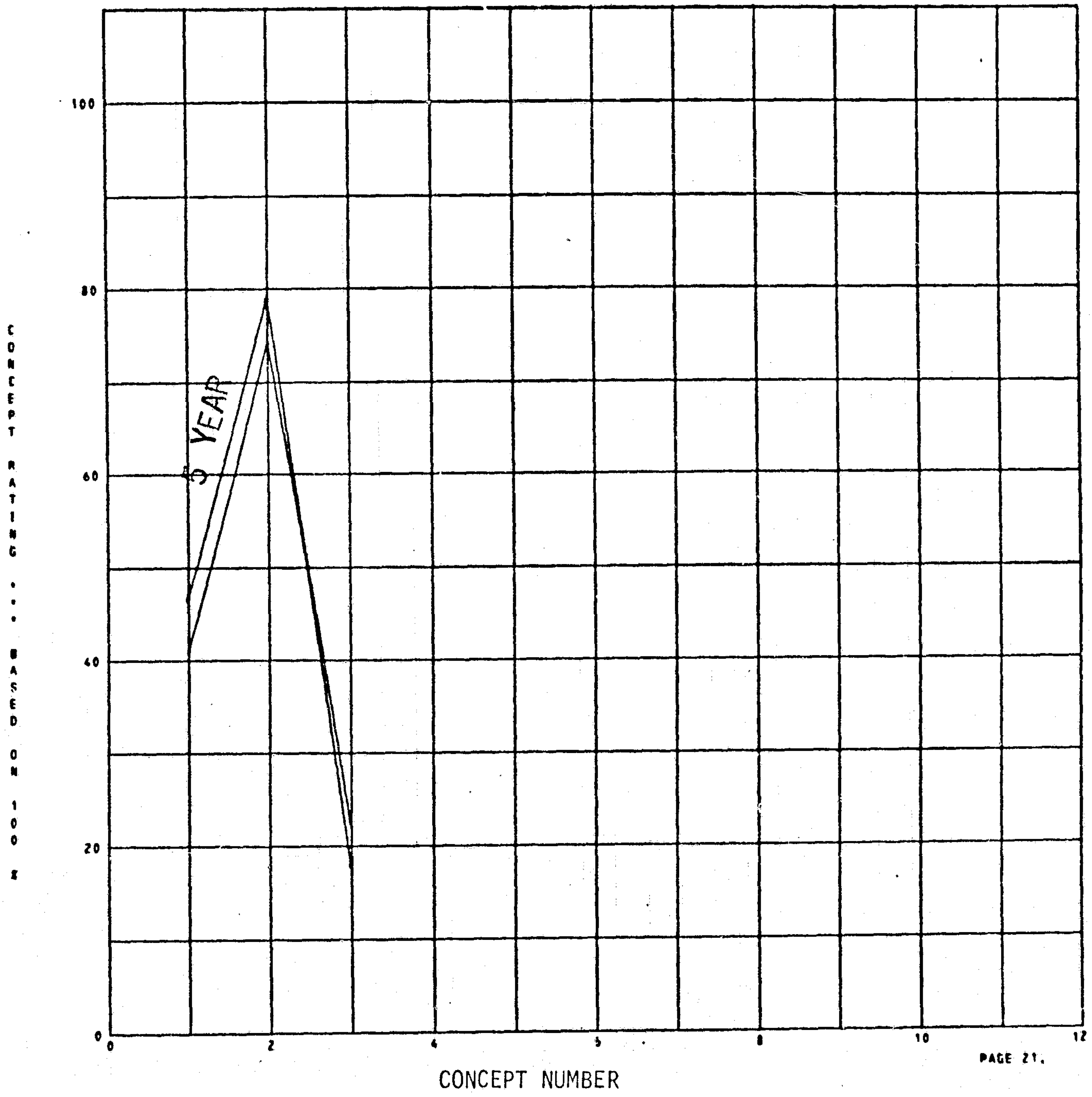


Figure 5-49. Refuse Disposal (Space Station) Concept Trade

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	-	MECHANICAL OSCILLATION
2	-	FLUIDIC AGITATION
3	-	PISTON AGITATION
4	-	CYCLIC VALVE AND PUMP AGITATION
5	-	DIAPHRAM ACTUATED-ONE DIRECTIONAL SQUEEZE
6	-	DIAPHRAM ACTUATED-TWO DIRECTIONAL SQUEEZE
7	-	WATER SPRAY AGITATED
8	-	ULTRASONIC
9	-	MANUAL WASHBOARD
10	-	PLAIN RECIRCULATION

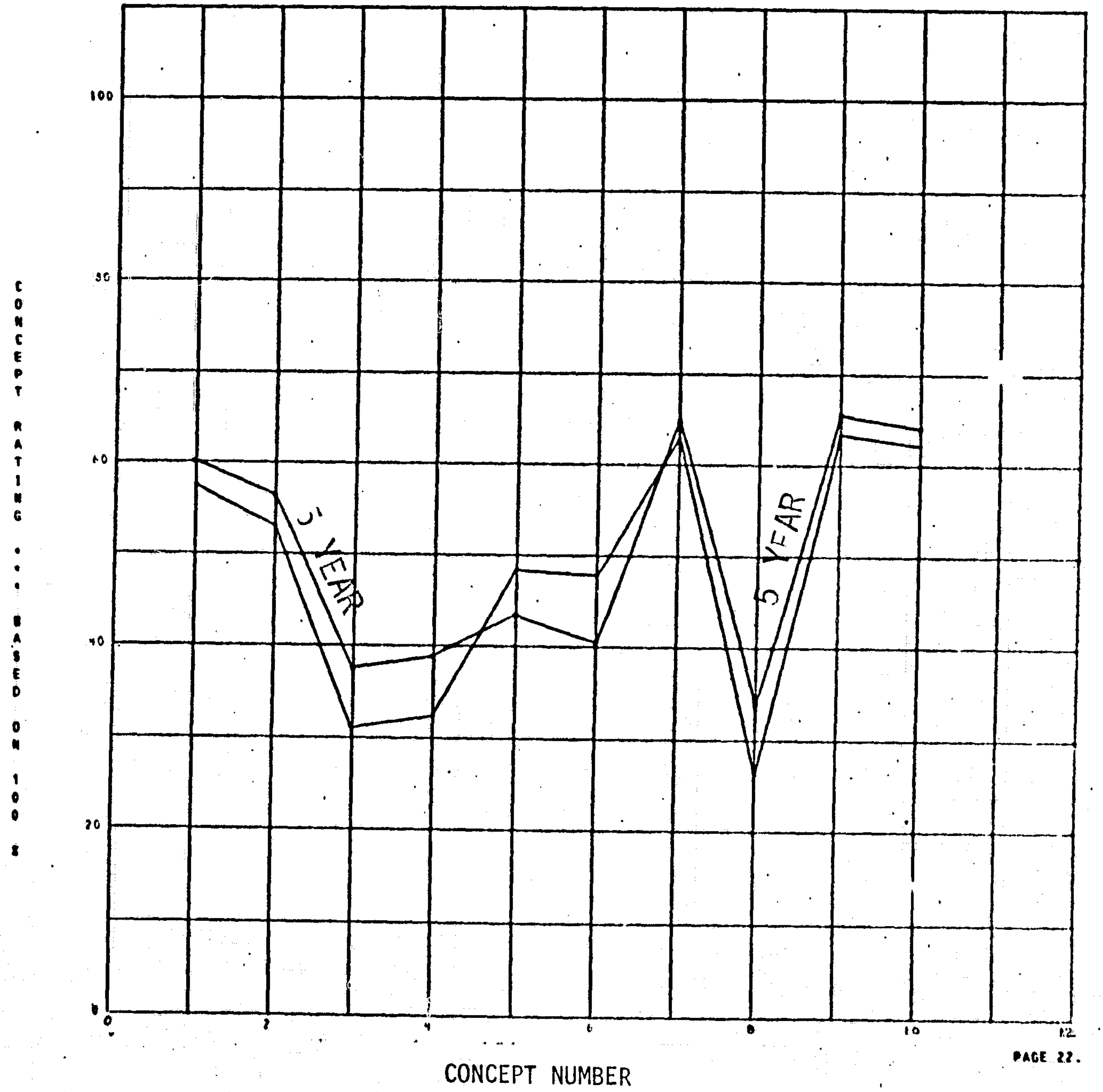


Figure 5-50. Garment/Linen Washing (Space Station) Concept Trade

APPLIANCE
CONCEPT
NO. CONCEPT NAME

1 - FORCED HOT AIR-ELECTRIC
2 - FORCED HOT AIR-HEAT FROM THERMAL STORAGE UNIT
3 - FORCED COLD DRY AIR-DISICCANT(VACUUM REGENERABLE)
4 - FORCED COLD DRY AIR-DISICCANT(ELECTRIC HEAT REGENERABLE)
5 - VACUUM DRY
6 - THERMAL VACUUM DRY-ELECTRIC HEAT
7. - THERMAL VACUUM DRY-THERMAL STORAGE/RADIANT HEAT
8 - CLOTHES LINE-FORCED CONVECTION
9 - CLOTHES LINE-FORCED CONVECTION+ELECTRIC HEAT

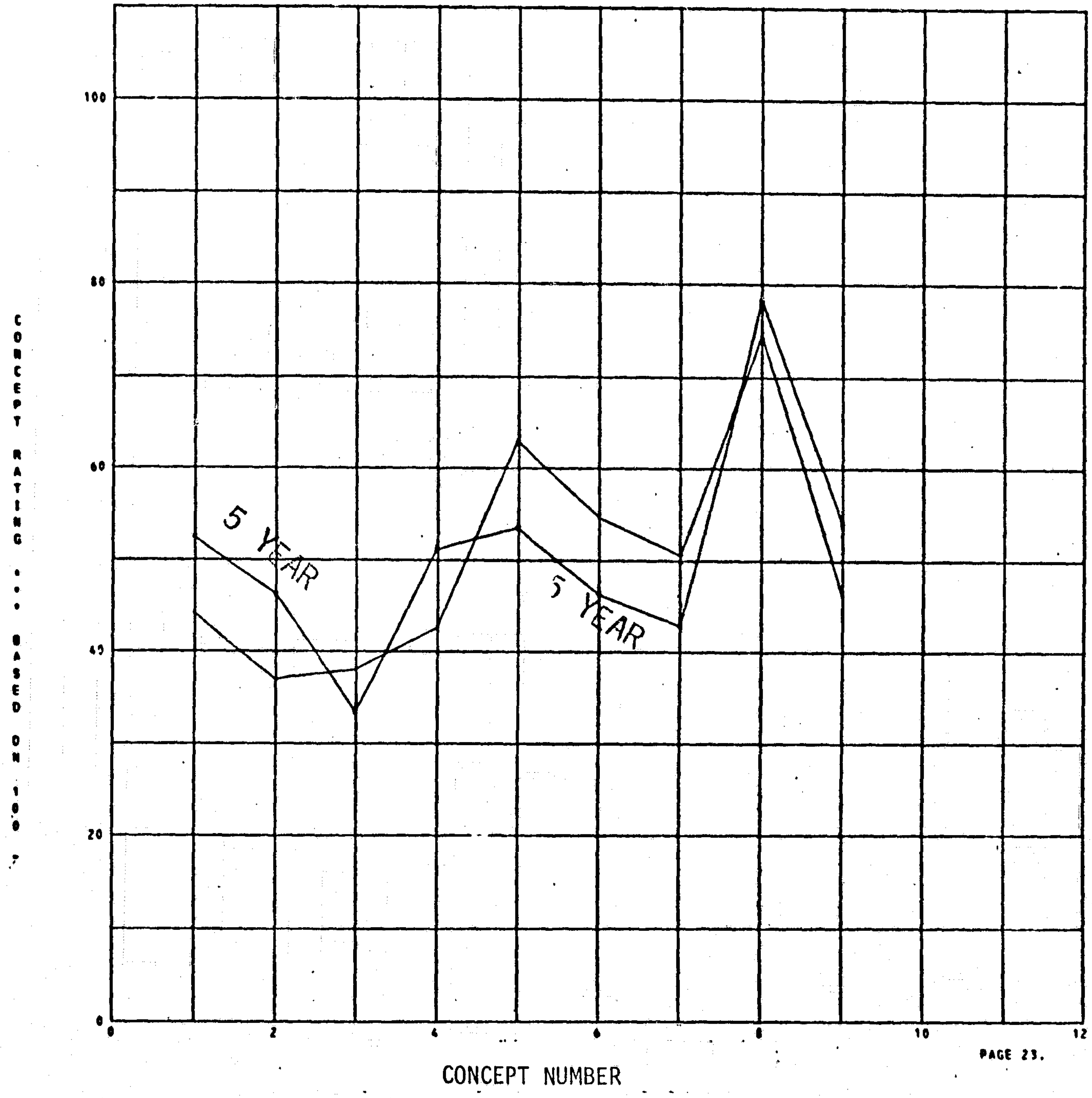


Figure 5-51. Garment/Linen Drying (Space Station) Concept Trade

APPLIANCE CONCEPT NO.		CONCEPT NAME
1	-	FLUIDIC AGITATION/FORCED HOT AIR-ELECTRIC HEATER
2	-	FLUIDIC AGITATION/FORCED HOT AIR-THERMAL STORAGE HEATER
3	-	FLUIDIC AGITATION/FORCED AIR DRYING-CLOTHES LINE
4	-	FLUIDIC AGITATION/FORCED AIR DRYING-CLOTHES LINE
5	-	WATER SPRAY AGITATION/FORCED HOT AIR-ELECTRIC HEATER
6	-	WATER SPRAY AGITATION/FORCED HOT AIR-THERMAL STORAGE HEATER
7	-	WATER SPRAY AGITATION/FORCED AIR DRYING-CLOTHES LINE
8	-	WATER SPRAY AGITATION/ELECTRICALLY HEATED-CLOTHES LINE
9	-	DISPOSABLE CLOTHES

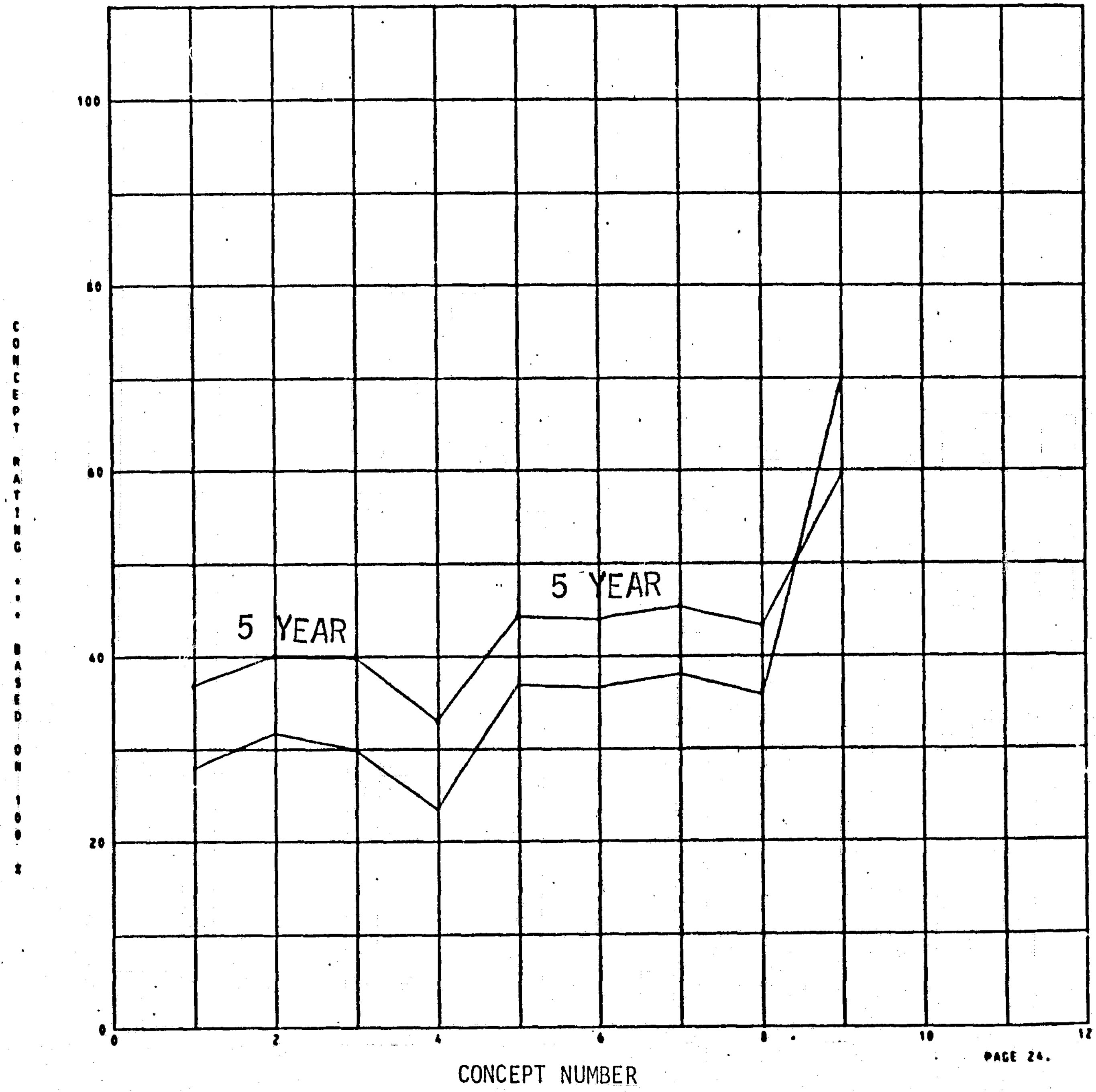


Figure 5-52. Garment/Linen Washer/Dryer-Disposable Clothes (Space Station) Concept Trade

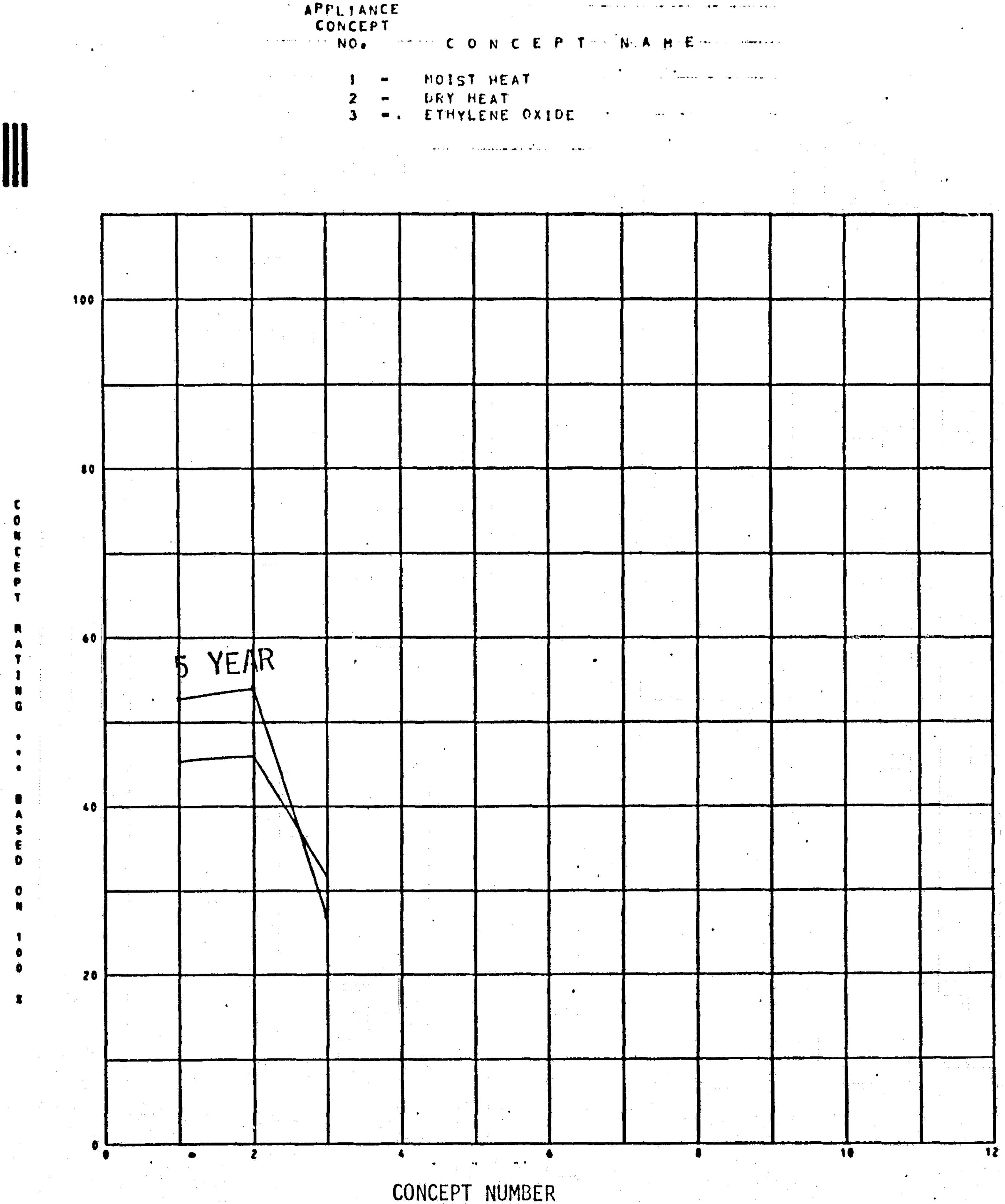


Figure 5-53. Autoclaves (Space Station) Concept Trade

6.0 CREW APPLIANCE SYSTEM OPTIMIZATION

Results of the trade study discussed in the previous section provided an initial list of appliance concepts which individually best satisfy the electrical, weight, and volume requirements for the Shuttle and Space Station missions (described in Paragraph 3.1), with a minimum thermal penalty to the spacecrafts ECLSS. In this section, the optimized appliance systems are developed which will as an aggregate of these concepts, or alternates, provide appliance systems which will best satisfy each vehicle's requirements.

Optimization of the Shuttle and Space Station appliance systems was initiated by first assembling the habitability subsystem with appliance concepts chosen in the trade studies. Heat rejection, electrical power, weight, and volume characteristics of the optimum subsystem were compared to the vehicle subsystem requirements; and when deficiencies existed, concepts were exchanged to reduce them. In some instances, crew convenience was an overriding factor in the concept selection. Once the deficiencies were reduced to a minimum, the subsystems were incorporated into the total appliance system.

Characteristics of the optimized appliance system were compared to the total spacecraft appliance system requirements, and again the appliance concept selection was reviewed to reduce system deficiencies where they existed. The optimum crew appliance system is comprised of the final appliance concepts chosen in this process. Procedures used in the process

6.0 (Continued)

are discussed for the Shuttle and Space Station in the following Paragraphs 6.1 and 6.2, respectively. Detailed descriptions and performance data of the concepts chosen and those considered in the trades are included in Appendices B and C.

6.1 SHUTTLE APPLIANCE SYSTEM OPTIMIZATION

Because of the short mission duration and small crew size, the Shuttle has requirements for only a few major appliance functions; of these refrigerated storage, food warming, and fecal/urine collection call for more complex concepts. Other appliance functions require simplistic concepts or disposable items. The appliance concepts chosen for the Shuttle system are listed in Table 2-1 of the Summary (Paragraph 2.0), and illustrations of the concepts chosen are shown for each subsystem in Figure 6-1.

Requirements for the Shuttle appliance system were well defined in Reference 276 (see Paragraph 4.1), and a good comparison of major operating characteristics could be made against those of the optimum system.

6.1.1 Shuttle Optimized Food Management Subsystem

The appliance functions and corresponding concepts which were rated highest in the trade program are listed below for the food management subsystem:

- Refrigerated Food Storage

  Concept - Space Radiator

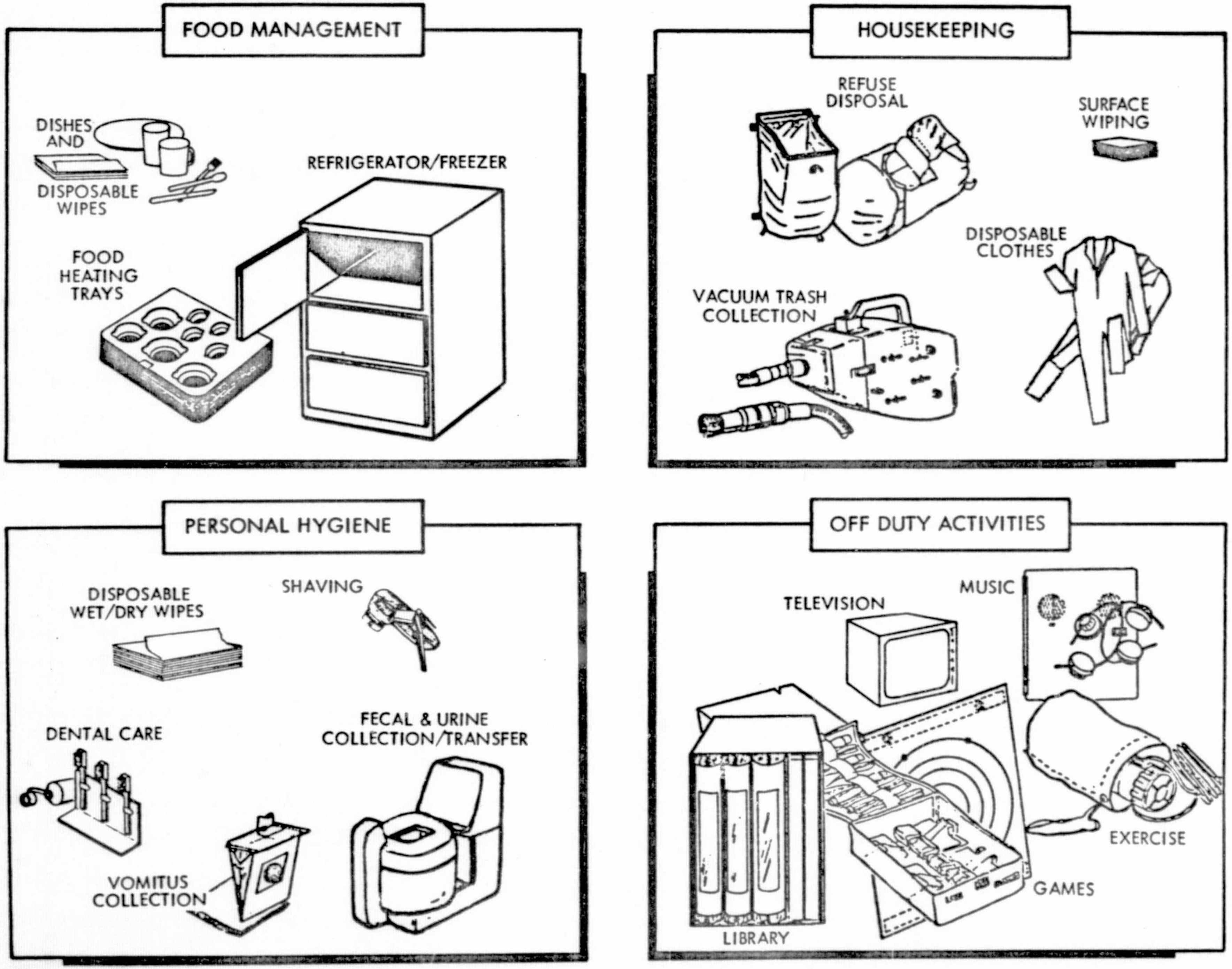


FIGURE 6-1 SELECTED SHUTTLE APPLIANCE CONCEPTS

6.1.1 (Continued)

- Food Warming

  Concept - Heating Trays

- Galley Cleanup

  Concept - Reusable Metallic Dishes and Utensils plus Disposable Wet/Dry Wipes

Frozen food storage concepts were investigated and optimization trades were made; however, there are currently no requirements for frozen food storage on board the Shuttle Orbiter. Therefore, this appliance is not included in the system.

The refrigerated storage concept chosen is a circulated coolant-type with heat rejection being provided by a space radiator. Cooling coils integral to the storage box provide heat transfer medium. Liquid coolant supply at $4.4^{o}C$ ($40.0^{o}F$) is available from the Shuttle Freon loop. Compared with the thermoelectric concept, which rated second in the trade, the space radiator concept requires less electric power and a lower net thermal load to the Shuttle radiator system.

The food warming concept chosen was the Skylab-type heating trays, with electric convection oven second, and microwave ovens third. Heating trays warm the food over a longer period of time than the other two concepts considered and, consequently, has a lower heat transfer rate to the cabin atmosphere.

6.1.1 (Continued)

Several diverse concepts were considered for the galley cleanup function: mechanical dishwashers, manual dishwashers, reusable dishes with wipes, and disposable dishes. Of these, reusable dishes and disposable wet/dry wipes traded as the optimum concept. This concept of course has no heat rejection or electrical requirements. As could be expected, it rated highly in thermal and electrical trade but also rated better than mechanical dishwashers in the equipment weight.

Requirements for the food management subsystem components are tabulated in Table 6-1. Each of these components was highest rated in its respective trade. At the bottom of the table, the Shuttle vehicle requirements for this subsystem are compared against the optimum subsystem requirements. The optimum requirements are strictly a summation of the component requirements. Thermal and electrical loads were added directly since each of these appliances would be required to operate coincidentally.

The minus (-) sign indicates that the optimum system is within the vehicle requirement by the amount noted. The plus (+) sign indicates that optimum subsystem is outside the vehicle requirement by the amount shown. This convention will be observed in all comparisons made in Paragraphs 6.1 and 6.2. As seen in the deficiency line, the optimum subsystem thermal and electrical performance is within the vehicle requirements; however, the weight and volume exceed the vehicle requirements.

TABLE 6-1

SHUTTLE FOOD MANAGEMENT SUBSYSTEM OPTIMIZATION MATRIX

HABITABILITY FUNCTION	HEAT REJECTION		ELECTRIC POWER			WEIGHT	VOLUME
	COOLANT	HT LEAK	PEAK	AVG	DEMAND		
	WATTS (Btu/hr)	WATTS (Btu/hr)	WATTS	WATTS	WATT-HR DAY	KG (lbs)	M^3 (ft^3)
<u>FOOD STORAGE</u>							
o REFRIGERATED (SPACE RADIATOR)	8.8 (30.0)	41.3 (141.0)	500.0	TBD	TBD	8.9 (19.6)	0.041 (1.44)
<u>FOOD PREPARATION</u>							
o FOOD WARMING (HEATING TRAYS)		196.9 (672.0)	660.0	197.0	1182.0	36.6 (80.6)	0.136 (4.8)
<u>FOOD CLEANUP</u>							
o UTENSILS - DISHES (REUSABLE METALLIC)						13.0 (28.6)	0.027 (.95)
o CLEANING (DISPOSABLE WET/DRY WIPES)							
SUBSYSTEM TOTAL	8.8 (30.0)	238.2 (813.0)	710.0	TBD	TBD	58.5 (129.0)	0.204 (7.2)
VEHICLE SUBSYSTEM REQUIREMENTS (FROM TABLE 4-2)	8.4 (28.6)	721.9 (2463.9)	893.0	TBD	TBD	38.4 (94.7)	0.170 (6.00)
DEFICIENCY	+0.4 (+1.4)	-483.7 (-1650.9)	-183.0			+20.1 (+44.3)	+0.034 (+1.2)

6.1.2 Shuttle Optimized Personal Hygiene Subsystem

Appliance function and corresponding concepts for the personal hygiene subsystem which rated highest in the trade program or selected alternately are the following:

- Fecal/Urine Collection and Transfer
  - Concept - Dryjohn System
- Vomitus Collection
  - Concept - Disposable Bags
- Partial Body Cleansing
  - Concept - Disposable Wet/Dry Wipes
- Shaving
  - Concept - Safety Razor or Windup Razor
- Dental Hygiene
  - Concept - Typical Toothbrush with Dentifrice

The dryjohn was chosen as the concept to satisfy the fecal collection and transfer function. This concept was chosen although it rated third in the trade program behind the Apollo dry bag system and the Skylab semiautomatic bag system for fecal collection and transfer; and it rated fourth behind the Apollo cuff type, the Skylab intimate adapter, and the aperture urinal for urine collection and transfer. This choice was made to provide greater crew convenience than could be accorded by the higher rated systems. Also as discussed in Paragraph 4.1.2, this system is the type called out in the vehicle requirements. This system contains a collector unit to retain the waste and wipes for the entire mission duration. The collector volume

6.1.2 (Continued)

is held at a vacuum pressure level to reduce waste volume and inhibit bacteria presence.

The vomitus collection concept which rated the highest was the portable, disposable collector similar to the type used by commercial airlines.

Concepts chosen to fill the partial body cleansing function were the disposable prepackaged wet wipes and disposable dry wipes. Skylab-type disposable washcloths rated second and the mechanical system (automatic sponge) rated third in the trade program. Disposable wet wipes have a slightly higher weight and volume penalty than the mechanical system; however, there is no heat transfer or electric power requirement as used in the mechanical system. Also, the electric dryer method of drying (which rated second to the disposable dry wipes) has less of a weight and volume penalty than disposable wipes but has a heat transfer and electric power penalty.

The shaving function can be satisfied by either the safety razor or the windup razor depending on crewman preference. Since each of them has essentially the same weight and volume requirements and no heat transfer or electric requirement, they rated closely in the trade program.

The dental hygiene (teeth brushing) concept chosen was the typical toothbrush with a dentifrice supply.

6.1.2 (Continued)

The requirements for the optimum components of the personal hygiene subsystem discussed previously are listed in Table 6-2. These requirements are summed and compared with the vehicle requirements for this subsystem at the bottom of the table. As noted in the deficiency line of the table, the optimum subsystem is well within the vehicle subsystem requirements in all categories compared except heat leakage to the cabin atmosphere.

The reason for the large margin in favor of the optimum subsystem weight is attributable to the amount of expendables assigned in the vehicle requirements to the fecal/urine collection and transfer system and also the heavier mechanical system for partial body washing (Table 4-2). Also, the weight allowance for system includes the weight requirement for water.

6.1.3 Shuttle Optimized Housekeeping Subsystem

The appliance functions and corresponding concepts which rated highest in the trade study or selected alternately are listed below for the housekeeping subsystem:

- Surface Wiping
  Concept - Disposable Wet/Dry Wipes (prepackaged)
- Manual Refuse Collection
  Concept - Disposable Bags
- Vacuum Refuse Collection
  Concept - Electric Vacuum Cleaner

TABLE 6-2

SHUTTLE PERSONAL HYGIENE SUBSYSTEM OPTIMIZATION MATRIX

HABITABILITY FUNCTION	HEAT REJECTION		ELECTRIC POWER			WEIGHT	VOLUME
	COOLANT	HT LEAK	PEAK	AVG	DEMAND		
	WATTS (Btu/hr)	WATTS (Btu/hr)	WATTS	WATTS	WATT-HR DAY	KG (lbs)	M^3 (ft^3)
WASTE COLLECTION/TRANSFER							
o FECAL/URINE COLLECTION (DRYJOHN SYSTEM)		200.1 (683.0)	675.0	440.0	TBD	148.8 (328.0)	0.850 (30.0)
o VOMITUS COLLECTION (DISPOSABLE BAGS)						5.4 (1.2)	0.000 (0.0)
BODY CLEANSING (WET/DRY WIPES)						43.5 (96.0)	0.062 (2.2)
PERSONAL GROOMING							
o SHAVING (WINDUP RAZOR)						0.5 (1.0)	0.003 (0.1)
o DENTAL (TOOTHBRUSH + DENTIFRICE)						6.4 (14.0)	0.034 (1.2)
SUBSYSTEM TOTAL		200.1 (683.0)	675.0	440.0	TBD	199.7 (440.2)	0.949 (33.5)
VEHICLE SUBSYSTEM (FROM TABLE 4-1) REQUIREMENTS		165.0 (563.1)	805.0	TBD	(636.6)	588.4 (1297.2)	1.546 (54.6)
DEFICIENCY		+35.1 (+119.9)	-130.0	☒	☒	-388.7 (-857.0)	0.598 (-21.1)

6.1.3 (Continued)

- <u>Refuse Storage</u>

  Concept - Storage Bin/Container

- <u>Garment/Linen Maintenance</u>

  Concept - Disposable Clothes

The concept which traded highest for the surface wiping function was the disposable, prepackaged wet wipe and disposable dry wipe. This concept required the least weight penalty and had no thermal or electrical requirements. The second highest rated concept was the Skylab-type disposable cloth and dry wipe. This concept has the smallest volume requirement. Other concepts considered which required a mechanical wetting system or equipment to wash and dry reusable wipes rated poorly.

Disposable trash bags were chosen for manual refuse collection.

For the vacuum refuse collection function, the Skylab-type electric vacuum cleaner was chosen. This concept ranked second to a vacuum vented system in view of the thermal and electrical power requirements. However, because of the Shuttle overboard venting prohibition, the electric vacuum cleaner was chosen. The third concept considered was a commercial-type vacuum cleaner. It ranked third in the trade study because of a higher electrical power consumption and commensurate heat transfer rate.

The refuse disposal function was filled by the storage bin/container concept which ranked ahead of the vacuum storage concept. Neither concept has a

6.1.3 (Continued)

thermal or electrical requirement; however, the vacuum storage concept has a weight penalty which is an order of magnitude greater than the bin concept.

Trash compactor concepts were traded for the refuse processing function. However, because there is no requirement for a compactor on the Shuttle vehicle, this function was not included in the housekeeping subsystem.

Disposable clothes was the concept which traded highest for garment/linen maintenance. Several combinations of mechanical washer/dryer systems were studied and traded; however, these concepts ranked poorly against disposable clothes because of their inherent thermal, power, and weight (due to cleaning fluid requirements) penalties.

The requirements for the housekeeping subsystem components are listed in Table 6-3. Components shown are those which rated highest in the trade studies and were selected for the reasons discussed above. Of these appliance components, only the vacuum cleaner has a thermal or electrical requirement. The weights and volumes shown in Table 6-3 were added directly to form the system total at the bottom of the table. The vehicle subsystem requirements are shown also and the deficiencies noted. As seen from the table, the optimum subsystem requirements exceed those of the vehicle in all categories. However, since the concepts are essentially the same in both the optimum and vehicle systems for all functions (wet/dry wipes, disposable clothes, etc.) and because the most recent data were used to

TABLE 6-3

SHUTTLE HOUSEKEEPING SUBSYSTEM OPTIMIZATION MATRIX

HABITABILITY FUNCTION	HEAT REJECTION		ELECTRIC POWER			WEIGHT	VOLUME
	COOLANT WATTS (Btu/hr)	HT LEAK WATTS (Btu/hr)	PEAK WATTS	AVG WATTS	DEMAND WATT-HR DAY	KG (lbs)	M^3 (ft^3)
EQUIPMENT CLEANING (WET/DRY WIPES)						39.1 (86.3)	0.079 (2.8)
REFUSE MANAGEMENT							
o MANUAL COLLECTION						6.6 (14.6)	0.088 (3.1)
o VACUUM COLLECTION (ELEC. VACUUM CLEANER)		76.8 (262.0)	115.0	TBD	TBD	13.8 (30.4)	0.023 (.8)
o REFUSE STORAGE (STORAGE BINS)						8.7 (19.2)	0.387 (13.3)
GARMENT/LINEN MAINTENANCE (DISPOSABLE CLOTHES AND LINENS)						51.7 (114.0)	0.609 (21.5)
SUBSYSTEM TOTAL		76.8 (262.0)	115.0	TBD	TBD	120.0 (264.5)	1.175 (41.5)
VEHICLE SUBSYSTEM (FROM TABLE 4-4) REQUIREMENTS		60.1 (205.0)	80.0	60.0	120.0	41.0 (90.4)	0.521 (18.4)
DEFICIENCY		+16.7 (+57.0)	+35.0			79.3 (+174.3)	+0.654 (+23.1)

6.1.3 (Continued)

determine the optimum concept's weight, volume, etc., optimum subsystem values are assumed to be irreducible.

6.1.4 Shuttle Optimized Off-Duty Activities Subsystem

The appliances for Shuttle off-duty activities were not traded for determination of the optimum concepts. Rather, the characteristics of typical items were determined (some commercially available) and compiled for this subsystem. The results of this compilation are shown in Table 6-4. All the requirements for the Shuttle mission recreation and physical conditioning activities are filled by those items listed.

6.1.5 Shuttle Optimized Appliance System

Results of the previous subsystem optimization program are compiled and tabulated in Table 6-5. Values listed in the table represent the characteristics of each subsystem derived in the previous paragraphs. The system total at the lower part of the table forms the optimum appliance system requirements. This total is a strict summation of the subsystem values with the exception of the heat rejection rate and peak electrical power. The housekeeping electrical power (vacuum cleaner) requirement was omitted from the sum because it was assumed that this function would not be conducted coincidentally with food preparation. This assumption was made also in defining the vehicle requirements (Paragraph 4.1).

TABLE 6-4
SHUTTLE OFF-DUTY SUBSYSTEM OPTIMIZATION MATRIX

HABITABILITY FUNCTION	HEAT REJECTION		ELECTRIC POWER			WEIGHT	VOLUME
	COOLANT	HT LEAK	PEAK	AVG	DEMAND		
	WATTS (Btu/hr)	WATTS (Btu/hr)	WATTS	WATTS	WATT-HR DAY	KG (lbs)	M^3 (ft^3)
ENTERTAINMENT							
o AUDIO SYSTEM		30.0 (102.4)	45.0	30.0	TBD	20.5 (45.2)	0.028 (1.0)
o BOOKS						0.5 (1.1)	0.003 (.1)
o TV		120.0 (409.6)	180.0	120.0	TBD	22.7 (50.0)	0.122 (4.3)
o GAMES						1.5 (3.3)	0.003 (.1)
PHYSICAL CONDITIONING							
o EXERCISE DEVICES						0.6 (1.3)	0.006 (.2)
SUBSYSTEM TOTAL		150.0 (512.0)	225.0	150.0	TBD	45.8 (100.9)	0.161 (5.7)
VEHICLE SUBSYSTEM (FROM TABLE 4-5) REQUIREMENTS		165.4 (564.4)	270.0	179.9	740.0	85.5 (188.5)	0.283 (10.0)
DEFICIENCY		-15.4 (-52.4)	(-45.0)			-39.7 (-87.5)	-0.122 (-4.3)

TABLE 6-5
SHUTTLE APPLIANCE SYSTEM OPTIMIZATION

HABITABILITY SUBSYSTEM	HEAT REJECTION		ELECTRIC POWER			WEIGHT	VOLUME
	COOLANT	HT LEAK	PEAK	AVG	DEMAND		
	WATTS (Btu/hr)	WATTS (Btu/hr)	WATTS	WATTS	WATT-HR DAY	KG (lbs)	M^3 (ft^3)
FOOD MANAGEMENT (FROM TABLE 6-1)	8.0 (30.0)	238.2 (813.0)	710.0	TBD	TBD	58.5 (129.0)	0.204 (7.2)
PERSONAL HYGIENE (FROM TABLE 6-2)		200.2 (683.0)	675.0	440.0	TBD	199.7 (440.2)	0.949 (33.5)
HOUSEKEEPING (FROM TABLE 6-3)		76.8 *(262.0)	*115.0	TBD	TBD	120.0 (264.5)	1.175 (41.5)
OFF-DUTY (FROM TABLE 6-4)		150.0 (512.0)	225.0	150.0	TBD	45.8 (100.9)	0.161 (5.7)
* OMITTED FROM TOTAL							
SUBSYSTEM TOTAL	8.8 (30.0)	588.3 (2008.0)	1610.0	TBD	TBD	423.9 (934.6)	2.489 (87.9)
VEHICLE SYSTEM (FROM TABLE 4-1) REQUIREMENTS	8.4 (28.6)	1052.2 (3591.2)	1876.0	TBD	TBD	753.0 (1660.0)	2.523 (89.1)
DEFICIENCY	+0.4 (+1.4)	-463.9 (-1583.2)	-266.0	X	X	-329.0 (-725.4)	-0.034 (-1.2)

6.1.5 (Continued)

The vehicle appliance system requirements are listed at the bottom of Table 6-5 and compared with optimized total. As seen from the comparison, the optimized system is within the vehicle requirements in all categories except in the heat rejected to the coolant which is only a 0.41 watt (1.4 Btu/hr) deficient. The optimized weight requirement is approximately 44 percent under the vehicle requirement due largely to the fact that the vehicle fecal/urine collection system requires a "wet" john and the optimized system utilizes a dryjohn concept. Also, a large vehicle weight penalty is required for a mechanical partial body washing device; whereas, the optimum system utilizes disposable wipes.

The optimized heat rejection rate penalty is smaller than the vehicle requirement by approximately 43 percent or 464 watts (1583 Btu/hr). As seen in Table 6-1, this results mostly from the food management subsystem; specifically, food warming. The reason for the large difference in heat rate is the difference in food warming rates between convective ovens (used in vehicle requirements) and food trays; food trays being slower.

The optimized appliance system devised for the Shuttle mission is well within or near the vehicle requirements with no loss to crewman convenience or system capability. The use of concepts other than those stated in the requirements and the use of disposables contributed to these reductions which provide a considerable weight savings and a reduced thermal load to the ECLSS.

6.2 SPACE STATION APPLIANCE SYSTEM OPTIMIZATION

The optimized Space Station appliance system includes the more complex appliance concepts to provide conveniences for the crewman during the extended mission durations. Some of these concepts were chosen over the higher trade-rated concepts with the sacrificing of a lower penalty for weight, volume, power, or thermal load. However, in many cases, the concept chosen for a particular appliance function was the optimum of several similar concept options if not of all concepts considered.

Consumable requirements and operational penalties were not defined for each appliance in Reference 29; only basic appliance characteristics were given. Thermal and electrical requirements are listed in this section for each of the optimum appliances whenever possible in order to provide the greatest amount of useful data. Thus, in many instances a direct comparison between the vehicle requirements and optimum system requirements could not be made. Consumable requirements (water, gas, detergents, germicides, etc.) were not included in the optimum appliance weight and volume values. These numbers were used in trades and are presented in Appendix C.

The same format used in describing the optimized Shuttle appliance system (Paragraph 6.1) is used in the following discussion of the Space Station system. For many appliance functions, the same concept is used in both appliance systems. The appliance concepts chosen for the Space Station are summarized in Table 2-2 of the Summary (Paragraph 2.0), and illustrations of the concepts are shown for each subsystem in Figure 6-2.

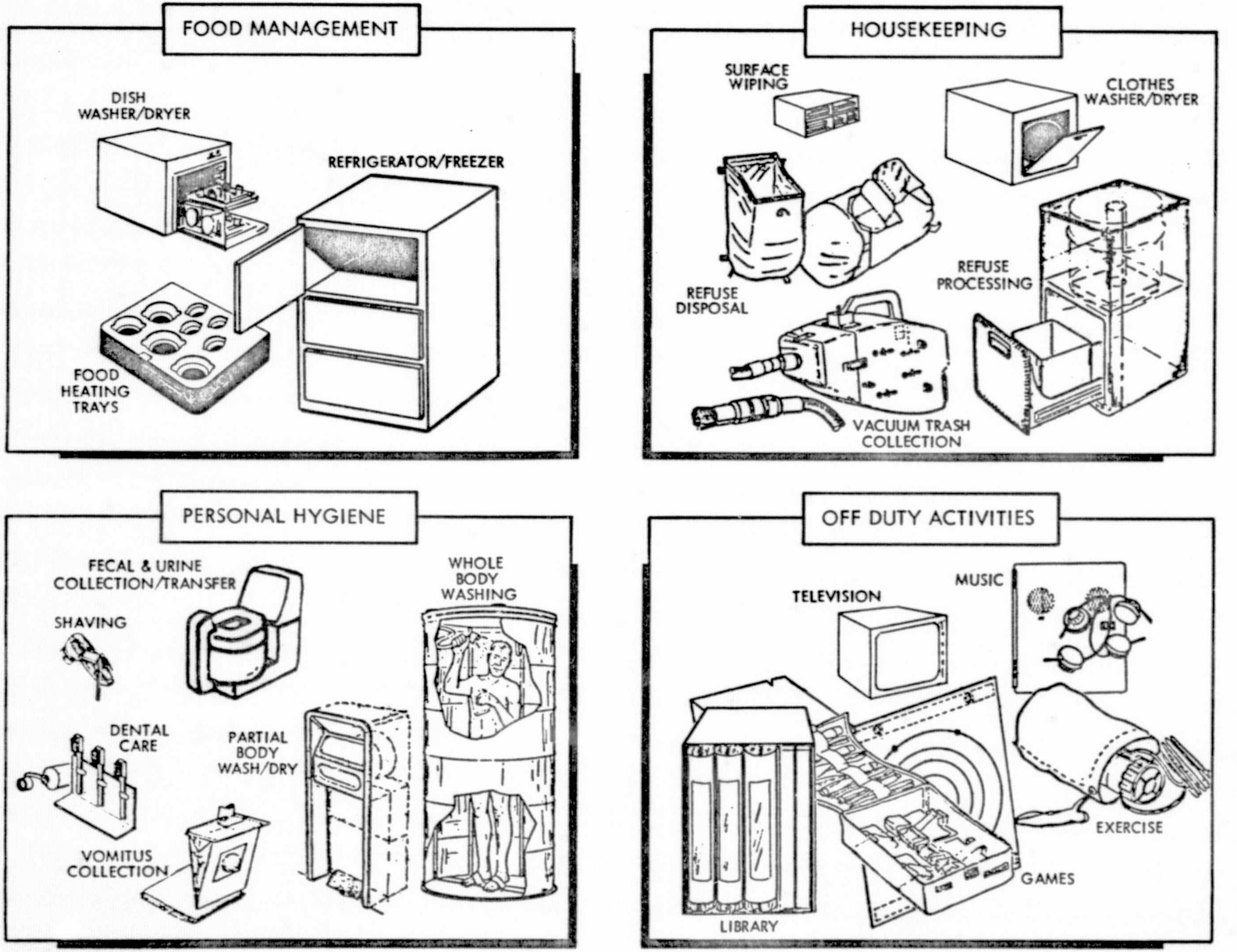


FIGURE 6-2 SELECTED SPACE STATION APPLIANCE CONCEPTS

6.2.1 Space Station Optimized Food Management Subsystem

The appliance functions and corresponding concepts which were rated highest in the trade program or selected alternately are listed below for the food management subsystem:

- Refrigerated Food Storage
  Concept - Space Radiator
- Frozen Food Storage
  Concept - Space Radiator
- Food Warming
  Concept - Heating Trays
- Galley Cleanup
  Concept - Water Spray Wash - Electric Heat Dry

As with the Shuttle, a space radiator concept of heat rejection traded as optimum for both the refrigerated and frozen food storage appliances. This concept, discussed in Paragraph 6.1.1, requires a space radiator system which will deliver the refrigerant to the freezer at -23°C (-10°F). The system requires one similar to that of the Skylab freezer; whereby, the radiator is directed away from the sun during earth orbit. Also, as with the Shuttle, the food warming concept chosen was the Skylab-type heating trays, with electric convection oven second, and microwave ovens third.

Concepts considered for the galley cleanup function were: mechanical dishwasher/dryers, manual dishwasher/dryers, reusable dishes with wipes,

6.2.1 (Continued)

and disposable dishes. Of these, reusable dishes and disposable wet/dry wipes traded as the optimum concept. The reason for this was the high ratings of this concept in all categories except weight; and because the optimum appliance system is heavier than the system requirements, a lighter mechanical system was picked. Also, the resupply weight of the mechanical system is comparatively low. Of the mechanical dishwasher/ dryers traded, the hot water spray device with centrifuge drying traded highest. However, because of the uncertainties of the centrifuge drying concept, an electric heat drying method was selected.

Requirements for the food management subsystem components are tabulated in Table 6-6. Each of these components was highest rated in its respective trade except those noted previously. At the bottom of the table, the Space Station vehicle requirements for this subsystem are compared against the optimum subsystem requirements. The sign convention, (+) or (-), discussed in Paragraph 6.1 will be used in this paragraph also. As in the requirements summation (Table 4-7), the optimum thermal and electrical power requirements were not summed directly since the food warming device and dishwasher were assumed to operate coincidentally. Peak electrical requirements were not defined in Reference 29; thus, a comparison of these values cannot be made. As seen in the deficiencies, the optimum subsystem weight and volume exceed the vehicle requirements; but the net heat rejection rate is within the requirements.

TABLE 6-6

SPACE STATION FOOD MANAGEMENT SUBSYSTEM OPTIMIZATION MATRIX

HABITABILITY FUNCTION	HEAT REJECTION		ELECTRIC POWER			WEIGHT	VOLUME
	COOLANT WATTS (Btu/hr)	HT LEAK WATTS (Btu/hr)	PEAK WATTS	AVG WATTS	DEMAND WATT-HR DAY	KG (lbs)	M^3 (ft^3)
FOOD STORAGE o REFRIGERATED (SPACE RADIATOR)	52.4 (179.0)	-2.3 (-8.0)	50	TBD	TBD	136.1 (300.0)	.623 (22.0)
o FROZEN (SPACE RADIATOR)	715.5 (2442.0)	-665.4 (-2271)	50	TBD	TBD	589.7 (1300.0)	2.705 (95.5)
FOOD PREPARATION o FOOD WARMING (HEATING TRAYS)		295.3 *(1008.0)	990.0	296.0	591.0	54.8 (120.9)	.204 (7.2)
GALLEY CLEANUP o DISHWASHER/DRYER (WATER SPRAY WASH/ ELECTRIC HEAT DRYING)	246.7 (842.0)	371.5 (1268.0)				59.9 (132.0)	.716 (25.3)
* OMITTED FROM TOTAL							
SUBSYSTEM TOTAL	1014.7 (3463.0)	-0.9 (-3.0)	1090.0	TBD	TBD	840.5 (1852.9)	4.248 (150.0)
VEHICLE SUBSYSTEM REQUIREMENTS	0.0 (0.0)	958.0 (3269.7)	TBD	958.0	TBD	532.2 (1173.3)	6.313 (222.9)
DEFICIENCY	+1014.7 (+3463.0)	281.6 (961.0)	TBD			+308.3 (+679.6)	2.06 (-72.9)

6.2.2 Space Station Optimized Personal Hygiene Subsystem

The appliance function and corresponding concepts which rated highest in the trade program or selected alternately are listed below for the personal hygiene subsystem:

- Fecal/Urine Collection and Transfer
  Concept - Dryjohn System
- Vomitus Collection
  Concept - Disposable Bags
- Whole Body Shower
  Concept - Collapsible Shower
- Partial Body Cleansing
  Concept - Reusable Wet/Dry Wipes
- Shaving
  Concept - Windup Razor
- Hair Cutting
  Concept - Razor Comb/Vacuum Collection
- Nail Care
  Concept - Manual Nail Clipper
- Dental Hygiene
  Concept - Typical Toothbrush with Dentifrice

The fecal/urine collection and transfer system chosen was the dryjohn concept. As noted previously, this system provides greater crew convenience, although it traded lower than the simpler concepts.

6.2.2 (Continued)

The vomitus collection concept which rated the highest was the portable, disposable collector similar to the type used on commercial airlines. The collapsible shower was the concept which rated the highest for whole body shower function, and the rigid wall system (mechanical) using towels to pick up water rated second. The collapsible shower is the type used on the Skylab mission which employs a nonrigid, fabric cylinder about the crewman to contain the shower water. This concept provided a smaller weight penalty than the conventional rigid wall type.

The concept which rated highest in the trade for partial body cleansing was the disposable prepackaged wet wipes. This resulted essentially because this concept has no heat rejection or electrical penalty. However, because of the large weight and volume penalty of this concept and because a clothes washer/dryer was to be included in the system (see Paragraph 6.2.3), the decision was made to use reusable wet wipes with a mechanical wetting device. Reusable dry wipes rated highest for the partial body drying and was included in the system.

The windup razor was rated highest for the shaving appliance and was selected. The vacuum-driven razor rated second. Hair cutting function was satisfied by a razor comb device with vacuum hair collection. Nail clippers are the commercial type, and the dental hygiene (teeth brushing) concept chosen was the typical toothbrush with a dentifrice supply.

6.2.2 (Continued)

The requirements for the optimum components of the personal hygiene subsystem discussed previously are listed in Table 6-7. These requirements are summed directly. The optimum subsystem exceeds the vehicle requirements in all categories.

6.2.3 Space Station Optimized Housekeeping Subsystem

The appliance functions and corresponding concepts which rated highest in the trade study or selected alternately are listed for the housekeeping subsystem.

- Surface Wiping
  Concept - Reusable Wet/Dry Wipes
- Manual Refuse Collection
  Concept - Disposable Bags
- Vacuum Refuse Collection
  Concept - Electric Vacuum Cleaner (Skylab-type)
- Refuse Processing
  Concept - Compactor (air pressure)
- Refuse Storage
  Concept - Storage Bin/Container
- Garment/Linen Maintenance
  Concept - Water Spray Agitation/Electric Heat Drying

The concept which traded highest for the surface wiping function was the disposable, prepackaged wet wipe and disposable dry wipe. This concept

TABLE 6-7

SPACE STATION PERSONAL HYGIENE SUBSYSTEM OPTIMIZATION MATRIX

HABITABILITY FUNCTION	HEAT REJECTION		ELECTRIC POWER			WEIGHT	VOLUME
	COOLANT	HT LEAK	PEAK	AVG	DEMAND		
	WATTS (Btu/hr)	WATTS (Btu/hr)	WATTS	WATTS	WATT-HR DAY	KG (lbs)	M^3 (ft^3)
<u>WASTE COLLECTION/TRANSFER</u> o FECAL/URINE COLL. (DRYJOHN)		200.1 (683.0)	675.0	440.0	204.0	183.8 (405.1)	0.954 (33.7)
o VOMITUS COLLECTION (DISPOSABLE BAGS)						7.0 (15.5)	0.003 (0.1)
<u>BODY CLEANSING</u> o WHOLE BODY SHOWER (COLLAPSIBLE)	77.2 (264.0)	253.1 (864.0)	85.5	85.5	128.4	71.7 (158.0)	1.385 (48.9)
o PARTIAL BODY WASHING (REUSABLE WIPES)	105.5 (360.0)	277.8 (948.0)	500.0	361.0		25.0 (55.2)	0.382 (13.5)
o PARTIAL BODY DRYING (REUSABLE WIPES)						1.5 (3.4)	0.062 (2.2)
<u>PERSONAL GROOMING</u> o MISC. TOILET ITEMS (SEE PARA. 6.2.2)						79.7 (175.8)	0.280 (9.9)
SUBSYSTEM TOTAL	182.8 (624.0)	731.0 (2445.0)	1260.5	886.5	TBD	368.8 (813.0)	3.067 (108.3)
VEHICLE SUBSYSTEM REQUIREMENTS	TBD	298.9 (1020.4)	TBD	299.0	TBD	287.3 (633.3)	2.852 (100.7)
DEFICIENCY	TBD	+432.1 (+1474.6)	TBD			81.5 (+179.7)	.215 (+7.6)

6.2.3 (Continued)

has no thermal or electrical requirements. Second highest rated concept was the Skylab-type disposable cloth and dry wipe. This concept has the smallest volume requirement. Other concepts considered which required a mechanical wetting system or equipment to wash and dry reusable wipes rated poorly. However, because of the excessive weight and volume penalty for the disposable wipes compared to reusable ones and because of the availability of clothes washer/dryer onboard, reusable wipes were chosen as the surface wiping concept. The wetting unit is a duplicate of the system used in the partial body cleansing appliance (Paragraph 6.2.2). The decision was made to include two wetting units because of the frequency of use.

Disposable trash bags were chosen for manual refuse collection. For the vacuum refuse collection function, the Skylab-type electric vacuum cleaner was chosen. However, the space-vented vacuum cleaning rated closely to the electric concept (Figure 5-47).

The refuse compactor concept chosen was the air pressurized device. This system has no thermal or electrical penalties. The second rated concept is vacuum operated and has essentially the same characteristics as the pressurized concept but has a higher weight penalty. The compactor is a necessary appliance because of the large volume of trash generated during the long duration missions.

6.2.3 (Continued)

The refuse disposal function was filled by the storage bin/container concept which ranked ahead of the vacuum storage concept. Neither concept has a thermal or electrical requirement; however, the vacuum storage concept has a weight penalty (due to cabin air lost during each cycle) which is considerably higher. Both have essentially the same volume requirements when traded directly without compaction. Since a compactor is onboard, the trash volume can be reduced to 20 percent of the original volume.

Disposable clothes was the concept which traded highest for garment/linen maintenance. Several combinations of mechanical washer/dryer systems were studied and traded; however, these concepts ranked poorly against disposable clothes because of their inherent thermal, power, and development penalties. Of the mechanical concepts considered, the water spray agitation concept with clothesline drying rated highest. Because of the large weight and volume of disposable clothes (and thus high resupply costs), a mechanical washer/dryer concept was chosen instead. The concept chosen was the integral spray washer with electric heat drying. Although the clothesline drying traded higher, it was considered a crew inconvenience. Weight and volume of clothes and linen necessary to maintain an adequate supply during the mission were added to the appliance weight and volume, respectively.

The requirements for the housekeeping subsystem components are listed in Table 6-8. The components shown are those which rated highest in the trade

TABLE 6-8

SPACE STATION HOUSEKEEPING SUBSYSTEM OPTIMIZATION MATRIX

HABITABILITY FUNCTION	HEAT REJECTION		ELECTRIC POWER			WEIGHT	VOLUME
	COOLANT	HT LEAK	PEAK	AVG	DEMAND		
	WATTS (Btu/hr)	WATTS (Btu/hr)	WATTS	WATTS	WATT-HR DAY	KG (lbs)	M^3 (ft^3)
<u>EQUIPMENT CLEANING</u>							
o SURFACE WIPING (REUSABLE WET/DRY WIPES)	105.5 (360.0)	277.8 (948.0)	500.0	TBD	TBD	14.7 (32.5)	0.176 (6.2)
<u>REFUSE MANAGEMENT</u>							
o MANUAL COLLECTION (DISPOSABLE BAGS)						153.1 (337.5)	0.634 (22.4)
o VACUUM COLLECTION (ELECTRIC VACUUM CLEANER)		76.8 (262.0)	115.0	115.0		13.8 (30.4)	0.0255 (0.9)
o REFUSE PROCESSING (COMPAC-AIR PRESS)		10.0 (34.1)	10.0	10.0		55.9 (123.2)	0.210 (7.4)
o REFUSE STORAGE (STOR BIN/CONTAINER)						44.3 (97.6)	3.313 (117.0)
<u>GARMENT/LINEN MAINT.</u>							
o WASHER/DRYER (WATER SPRAY AGIT/ ELEC. HEAT DRYING)	197.8 (675.0)	1470.9 (5020.0)	227.0			170.1 (375.0)	1.232 (43.5)
SUBSYSTEM TOTAL	303.3 (1035.0)	1835.3 (6264.1)	852.0	TBD	TBD	451.9 (996.2)	5.591 (197.4)
VEHICLE SUBSYSTEM REQUIREMENTS	TBD	TBD	TBD	299.0	TBD	(589.8)	2.580 (91.1)
DEFICIENCY	TBD	TBD	TBD			(+406.4)	3.010 (+106.3)

6.2.3 (Continued)

studies or were selected for the reasons discussed previously. The weights and volumes shown in Table 6-8 were added directly to form the system total at the bottom of the table. Because of the lack of definition of the vehicle heat rejection and electrical power requirements, a comparison of these items could not be made. As seen in the deficiency line of the table, the optimized weight and volume are not within the spacecraft requirements for the subsystem. This deficiency is due mainly to the large volume and weight requirement of the refuse management function compared to those of the vehicle requirements.

6.2.4 Space Station Optimized Off-Duty Activities Subsystem

Appliances for Space Station off-duty activities were not traded for determination of the optimum concepts. As with the Shuttle off-duty appliance selections, the characteristics of the typical concepts were determined and compiled for this subsystem. The results of the compilation are shown in Table 6-9. The vehicle requirements for off-duty equipment were not adequately defined to determine the specific components included. However, as noted in weight and volume deficiencies in the table, the optimum subsystem is within the vehicle requirements.

6.2.5 Space Station Optimized Appliance System

Results of the previous subsystem optimization program are compiled and tabulated in Table 6-10. Values listed in the table represent the characteristics of each subsystem derived in the previous paragraphs. The

TABLE 6-9

SPACE STATION OFF-DUTY SUBSYSTEM OPTIMIZATION MATRIX

HABITABILITY FUNCTION	HEAT REJECTION		ELECTRIC POWER			WEIGHT	VOLUME
	COOLANT	HT LEAK	PEAK	AVG	DEMAND		
	WATTS (Btu/hr)	WATTS (Btu/hr)	WATTS	WATTS	WATT-HR DAY	KG (lbs)	M^3 (ft^3)
<u>ENTERTAINMENT</u> o AUDIO SYSTEM		29.9 (102.4)	45.0	30.0	TBD	20.5 (45.2)	0.028 (1.0)
o BOOKS						6.7 (14.8)	0.0368 (1.3)
o TV		120.0 (409.6)	180.0	120.0	TBD	22.7 (50.0)	0.122 (4.3)
o GAMES						20.1 (44.4)	0.0368 (1.3)
<u>PHYSICAL CONDITIONING</u> o EXERCISE DEVICES						0.9 (1.95)	0.008 (0.3)
SUBSYSTEM TOTAL		150.0 (512.0)	225.0	1500.0	TBD	70.0 (154.4)	0.232 (8.2)
VEHICLE SUBSYSTEM REQUIREMENTS		TBD	TBD	TBD	TBD	170.1 (375.0)	3.398 (120.0)
DEFICIENCY				X	X	-100.1 (-220.6)	-3.166 (-111.8)

TABLE 6-10

SPACE STATION APPLIANCE SYSTEM OPTIMIZATION MATRIX

HABITABILITY SUBSYSTEM	HEAT REJECTION		ELECTRIC POWER			WEIGHT	VOLUME
	COOLANT	HT LEAK	PEAK	AVG	DEMAND		
	WATTS (Btu/hr)	WATTS (Btu/hr)	WATTS	WATTS	WATT-HR DAY	KG (lbs)	M^3 (ft^3)
FOOD MANAGEMENT (FROM TABLE 6-6)	1014.7 (3463.0)	-0.9 (-3.0)	1090.0	TBD	TBD	840.5 (1852.9)	4.248 (150.0)
PERSONAL HYGIENE (FROM TABLE 6-7)	182.8 (624.0)	731.0 (2495.0)	1260.5	TBD	TBD	368.0 (813.0)	3.067 (108.3)
HOUSEKEEPING (FROM TABLE 6-8)	303.3 (1035.0)	1835.3 (6264.1)	852.0	TBD	TBD	451.9 (996.2)	5.591 (197.4)
OFF-DUTY (FROM TABLE 6-9)		150.0 (512.0)	225.0	TBD	TBD	70.0 (154.4)	0.232 (8.2)
SYSTEM TOTAL	1500.8 (5122.0)	2715.5 (9268.1)	3427.5	TBD	TBD	784.9 (1730.4)	13.130 (463.9)
VEHICLE SYSTEM REQUIREMENTS	TBD	TBD	TBD			1257.1 (2771.4)	15.142 (534.7)
DEFICIENCY	TBD	TBD	TBD			472.2 (-1041.0)	-2.012 (-70.8)

6.2.5 (Continued)

system total at the lower part of the table forms the optimum appliance system requirements and is a strict summation of the subsystem values. As seen from the table, the optimized system is within the vehicle requirement for volume; however, the weight was 37 percent or 2280 kg (1033 lbs) greater than the vehicle requirements.

Total appliance system heat rate rejected directly to the coolant is 1650 watts (5563 Btu/hr), and the rate rejected to the cabin atmosphere is 2330 watts (7973 Btu/hr). Peak electrical power is 2529 watts. These values represent the maximum possible loads to the system. With adjustments to the duty cycles of the various appliances within a crew timeline, these rates can be reduced. These types of adjustments will be made prior to the end of the study and documented in the final report.

The system weight appears to be irreducible. Each subsystem weight, except off-duty, exceeded the vehicle requirement. A weight reduction could be accomplished by using the same appliance for dishwashing/drying and clothes washing/drying. This approach was investigated in Reference 90. However, with the use of one unit for a dual function, the appliance cycle time would have to be shortened to accommodate the total number of uses per day. This would then necessitate higher peak thermal and electrical loads to the system. The size of the appliance could be increased to reduce the use frequency, but would be self-defeating in terms of weight and volume.

CREW APPLIANCE CONCEPTS

APPENDIX A

BIBLIOGRAPHY

ILLUSTRATIONS

TABLE

1.0 INTRODUCTION

This appendix contains the results of the literature search conducted during the crew appliance study. A total of 682 references are included. Each reference was catalogued according to the type of appliance or vehicle to which it was related. For this purpose, a filing index was constructed to include all the types of appliances, vehicles, and related technology used during the crew appliance study, as shown in Figure A1-1. A generalized data handling program, COMPOSIT'77, available on the Commander-II System of Com-Share timesharing computer located at Ann Arbor, Michigan, was used to store, manipulate, and retrieve this information. For each reference, the following data were stored:

- Reference Identification Number
- Title
- Author(s)
- Date (month/day/year)
- Publishing Organization
- Contract Number
- NASA JSC Library Number
- Other Document Numbers
- Index Codes (from Filing Index, Figure A1-1)

The computer program is a highly flexible tool for collection, sorting, storage, analysis, and retrieval of generalized data in optional formats. Using this program, a complete alphabetized and sorted listing of the entire crew appliance bibliography was obtained.

1.0 VEHICLE REQUIREMENTS
1.1 SHUTTLE ORBITER
1.2 SPACELAB
1.3 MODULAR AND 33-FOOT SPACE STATION
1.4 SKYLAB
1.5 SPACE TUG
1.6 MANNED ORBITING LABORATORY (MOL)
1.7 RESEARCH AND APPLICATIONS MODULE (RAM)
1.8 SPACE STATION/BASE
1.9 APOLLO APPLICATIONS PROGRAM (AAP)
1.10 LUNAR BASE
1.11 APOLLO
1.12 LUNAR MODULE (LM)
1.13 INTERPLANETARY MANNED MISSIONS

2.0 FOOD MANAGEMENT
2.1 FOOD STORAGE (REFRIGERATOR/FREEZER/STORAGE MODULES)
2.2 FOOD PREPARATION
2.3 FOOD CLEANUP (DISHWASHER/DRYER, WIPES)
2.4 WORK/DINING AREAS
2.5 ANALYTICAL

3.0 PERSONAL HYGIENE
3.1 FECAL COLLECTION/TRANSFER/PROCESSING
3.2 URINE COLLECTION/TRANSFER/PROCESSING
3.3 VOMITUS COLLECTION/TRANSFER/PROCESSING
3.4 PARTIAL BODY WASHING/DRYING
3.5 WHOLE BODY SHOWER
3.6 DENTAL
3.7 SHAVING
3.8 HAIR/NAIL
3.9 GENERAL PERSONAL HYGIENE ITEMS
3.10 MICROBIAL CONTROL
3.11 ANALYTICAL

4.0 HOUSEKEEPING
4.1 EQUIPMENT CLEANING
4.2 TRASH COLLECTION
4.3 TRASH PROCESSING/DISPOSAL
4.4 LAUNDRY (DISPOSABLE/REUSABLE CLOTHING, WASHER/DRYER)
4.5 WASH WATER PROCESSING
4.6 MICROBIAL CONTROL
4.7 ANALYTICAL

5.0 RECREATION
5.1 AUDIO
5.2 VISUAL
5.3 EXERCISE

6.0 MEDICAL
6.1 EXPERIMENT MANAGEMENT
6.2 PREPARATION, PRESERVATION, AND RETRIEVAL EQUIPMENT (REFRIGERATORS/FREEZERS/OVENS)
6.3 RADIOBIOLOGY
6.4 DENTISTRY
6.5 MINOR SURGERY
6.6 ANALYTICAL

7.0 APPLIANCE-RELATED TECHNOLOGY
7.1 HEAT PIPES
7.2 ULTRASONIC
7.3 MICROWAVE
7.4 LASER
7.5 MICROBIOLOGICAL PROCESSES
7.6 DIALYSIS AND MEMBRANES
7.7 THERMOELECTRIC DEVICES
7.8 FUEL CELLS
7.9 ELECTROPHORESIS
7.10 LIGHT PIPES AND FIBER OPTICS

Figure A1-1. Crew Appliance Subject Filing Index

7.11 SPECIAL THERMAL INSULATION AND ISOLATION
7.12 BATTERIES
7.13 TANKS
7.14 MONITORING
7.15 METAL BELLOWS
7.16 FILTERS
7.17 CRYOGENIC COOLING
7.18 SEALS
7.19 SOLAR COLLECTOR
7.20 VALVES
7.21 SPACE RADIATORS
7.22 REFRIGERATION

Figure A1-1. Crew Appliance Subject Filing Index (concluded)

1.0 (Continued)

The resulting bibliography is composed of three parts. In Part I (Section 4), the title, date, publisher, and reference identification number are listed for each reference. The references are arranged in numerical order by identification number. The first 299 references are numbered 1 through 299 consecutively, and represent the references reviewed in detail and used during the crew appliance study. The following 383 references are numbered 1001 through 1383 consecutively. These references were located during the literature search but were not directly used for the crew appliance trade study.

In Part II (Section 5), all the references are listed in alphabetical order by title. With each reference is listed all the information described previously which is stored for it in the computer.

In Part III (Section 6), the references were sorted by their index code(s) from Figure A1-1 and listed alphabetically in a shortened form (title, date, and reference identification number). Examples of each of the bibliography sections are given in Figure A1-2. Thus, one can readily find (in Part III) every reference collected for any given appliance or vehicle category in the filing index (Figure A1-1). More detailed information about the references thus located may then be found by examining the long form for the same reference in Part II.

The information accumulated for all the references in the Crew Appliance Bibliography described above is permanently stored on Com-Share magnetic

PART I - NUMBERICAL REFERENCE LISTING

```
0001 - EUROPEAN SPACE RESEARCH ORGANIZATION SPACE SHUTTLE-SPACELAB DISCU
SSIONS,  , 04/17/73, NASA-JSC

0002 - SPACE SHUTTLE SYSTEM SUMMARY, ROCKWELL DOC. SSV73-45(R), 07/00/73
, ROCKWELL

0003 - SPACE SHUTTLE SYSTEM TECHNICAL REVIEW, ROCKWELL DOC. SSV73-26, 04
/16/73, ROCKWELL

0004 - SPACE SHUTTLE PROGRAM REVISED CABIN STUDY, ROCKWELL DOC. SSV73-13
, 03/13/73, ROCKWELL

0005 - ORBITER VEHICLE END ITEM SPEC. FOR THE SPACE SHUTTLE SYS., PART 1
, PERFORMANCE AND DESIGN REQUIREMENTS, SPEC. NO. MJ070-0001-1, 12/07/73,
```

PART II - ALPHABETICAL REFERENCE LISTING

```
0189 A BASELINE PROTOCOL FOR PERSONAL
HYGIENE-FINAL REPORT
ANON, FAIRCHILD
08/31/71, NAS 9-11509, FRD 3989, T71-15611
3.10

1001 A BIOMEDICAL PROGRAM FOR
EXTENDED SPACE.MISSIONS
ANON, NASA-JSC
05/00/69,  ,  , T73-11082
6.0

0229 A DEVICE FOR STORING AND DISPENSING
BITE-SIZE FOOD CUBES
J L MOORE, J R WATKINS, N G ROTH, WHIRLPOOL
07/13/71, F41609-69-C, SAM-TR-71-33, N72-15485
2.1

1002 A MICROBIAL SURVEILLANCE
SYSTEM
A K PRYOR AND C R MC DUFF, FAIRCHILD
00/00/68,  ,  ,
6.0
```

PART III - REFERENCES SORTED BY FILING INDEX

2.0 FOOD MANAGEMENT

```
A MICROWAVE FEEDING SYSTEM FOR EXTENDED SPACE MISSIONS, 12/69, 1003

A STUDY OF THE REACTION KINETICS FOR SEVERAL SPACECRAFT LIFE SUPPORT SYS
TEMS, 00/00, 1008

ACCEPTANCE TEST FOR LM OXYGEN BACTERIA FILTER, 03/68, 1010

ADVANCED METHODS OF RECOVERY FOR SPACE LIFE SUPPORT SYSTEMS, 00/73, 1013

ANALYSIS OF SELECTED CONSTITUENTS IN SPACE FOOD, 00/00, 1019
```

Figure A1-2. Examples of the Crew Appliance Bibliography Sections

1.0 (Continued)

tape 5398.BOEING.APPL(D=1600, T=9). These references may easily be searched, sorted, rearranged or added to by using the COMPOSIT'77 program. User instructions for operating the program are given in Sections 2 and 3.

2.0 REFERENCE INFORMATION STORAGE

Selected information (title, authors, etc.) from the 682 references located during the crew appliance literature search was entered into permanent storage on the Com-Share Commander II System. The data for each reference were stored by the computer in 12 data fields, as described in Table A2-1. A slash symbol (/) was used as a delimiter to separate data fields, and an "@" symbol used to denote the end of each reference. Bibliography references were then input by remote terminal to a storage file in the above format. Thus, a typical reference input file will appear as shown in Figure A2-1.

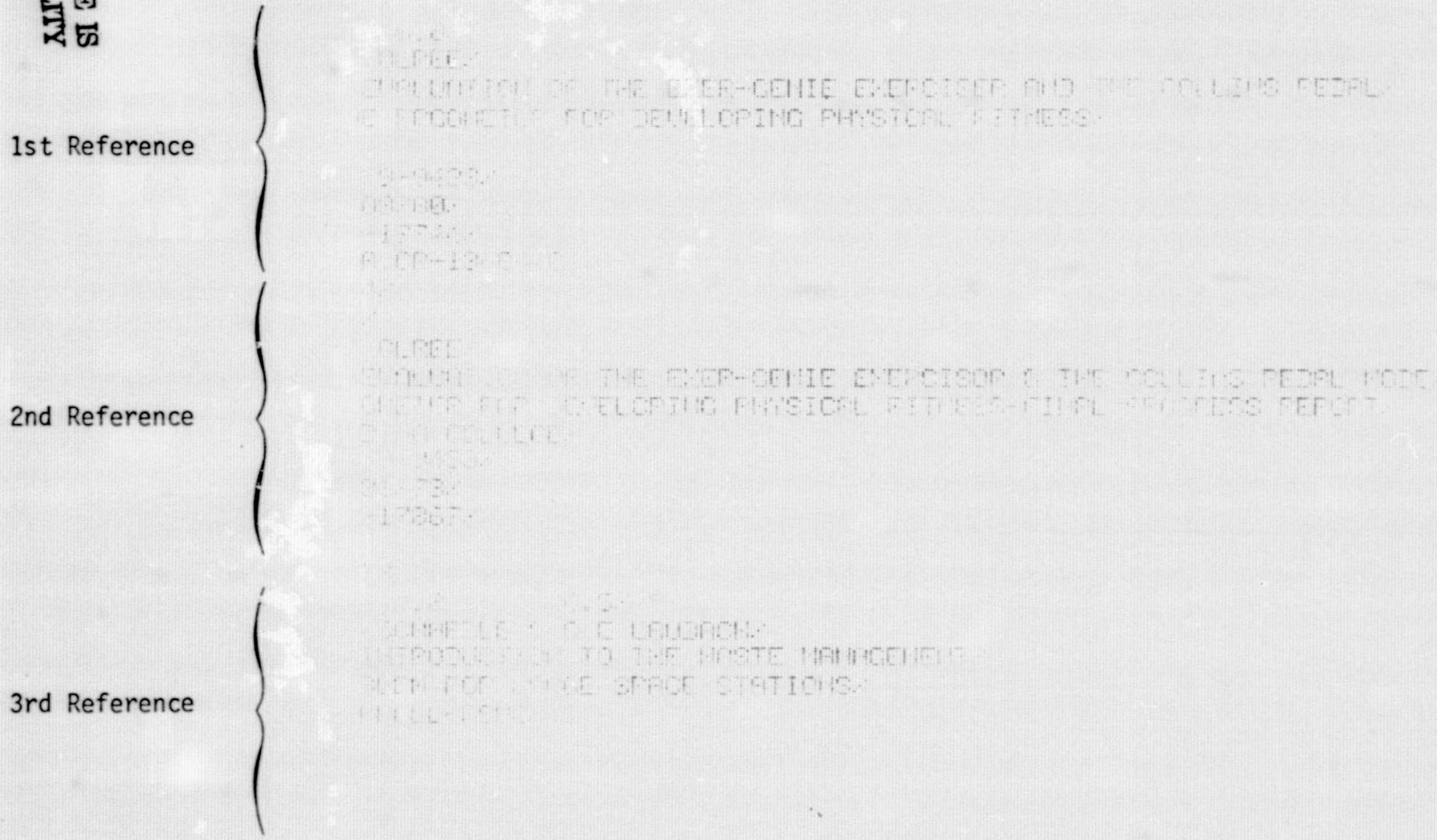
After all the desired references for a bibliography are entered into a symbolic file (i.e., in ordinary English alphabet characters and numbers), that file is used as input to the COMPOSIT'77 program which converts the information to a binary format for subsequent sorting and retrieval. The commands required to perform this operation are shown in Figure A2-2, assuming an input symbolic file name of /DATASYM and an output binary file name of /LIB.DATA. To execute these commands, the user must also have a "control" file named /LIB.CONT which describes to the computer the format of the references stored on the input symbolic file. The contents of this file used for the appliance bibliography, which assumed the reference format in Table A2-1, are listed in Figure A2-3.

By following the previous instructions, one can use any number of references in any format to create a binary bibliography file which can be subsequently

TABLE A2-1

INPUT FORMAT FOR STORING CREW APPLIANCE REFERENCE INFORMATION ON COMPUTER FILE

Computer Name for Data Field	Maximum Number of Characters Allowed for Data Field	Data Field Description
FILENUM	4	Reference Identification Number
INDEX	48	Applicable Reference Index Codes, from Figure A1-1
AUTHOR	48	Author(s) of reference
TITLE1	79	First line for reference title
TITLE2	79	Second line for reference title
PUBLISHER	36	Publishing organization
CONTRACT	12	Contract number under which work described in reference was performed.
PUBMO	2	Month of reference publishing date (2-digit number)
PUBDA	2	Day of Reference publishing date (2-digit number)
PUBYR	2	Year of reference publishing date (2-digit number)
LIBNUM	12	Reference NASA-JSC Library number
DOCNUM	36	Other Document numbers for reference



```
 NLPGE/
EVALUATION OF THE EXER-GENIE EXERCISER AND THE COLLINS PEDAL/
[illegible] ERGOMETER FOR DEVELOPING PHYSICAL FITNESS/

 [illegible]-9420/
09/80/
[illegible]1774/
A CP-12[illegible]
[illegible]
/

 NLPGE
EVALUATION OF THE EXER-GENIE EXERCISOR & THE COLLINS PEDAL MODE/
[illegible] FOR DEVELOPING PHYSICAL FITNESS-FINAL PROGRESS REPORT/
[illegible] COLLINS/
  [illegible]
[illegible]73/
[illegible]1786[illegible]


[illegible]2/
 [illegible] LAUBACH/
INTRODUCTION TO THE WASTE MANAGEMENT
[illegible] FOR [illegible] SPACE STATIONS/
[illegible]
```

Figure A2-1. Typical Reference Input File Format

```
SYSTEM: C77

C77> CREATE CONTROL /LIB.CONT TO /LIB.DATA!

WARNING:EOR OPTION OVERRIDES LINES OPTION
OLD BINARY TRACK? YES

CREATED BY 1414JAAX
ON DEC  4, 1974

      166
      332
      498
      664

683 RECORDS READ
683 RECORDS ON DAT.

CURRENT DATABASE FILE IS /LIB.DATA
C77> SYS
SYSTEM: GEN /PROG
```

NOTE: Underlined characters represent required input to be typed by user. The rest is printed automatically by the computer.

Figure A2-2. Binary Bibliography File Commands

/LIB.CONT FILE

```
[illegible]
SPECT[illegible]
[illegible]
[illegible]
[illegible]
LINES [illegible]
FIELDS [illegible]
FILENAME [illegible]
INDEX [illegible]
AUTHOR [illegible]
TITLE1 [illegible]
TITLE2 [illegible]
PUBLISHER [illegible]
CONTRACT [illegible]
[illegible]
[illegible]
[illegible]
```

Figure A2-3. Input Reference File Format Specifications

2.0 (Continued)

sorted, manipulated, and retrieved by the COMPOSIT'77 program. In summary, the following procedure is required to enter the Crew Appliance Bibliography to the COMPOSIT'77 program:

a. Enter the information for each of the references into a symbolic file using the format shown in Table A2-1 (as in example in Figure A2-1).

b. Name the above file /DATASYM.

c. Create a control file, named /LIB.CONT, as shown in Figure A2-3.

d. Execute the commands given in Figure A2-2 to convert the input information to binary format. The output bibliography file from this step will be /LIB.DATA.

The above procedure was followed to create the Crew Appliance Bibliography, and the resulting three files are permanently stored on Com-Share magnetic tape 5398.BOEING.APPL(D=1600,T=9). These files may be used in searching the bibliography for any of the references by the desired data field such as author, index code(s), key words in title, etc. The methodology used is described in Section 3.

3.0 REFERENCE INFORMATION SORT/RETRIEVAL

The COMPOSIT'77 program will sort the references in almost any manner desired, as well as search the references for any stored information in any of the data fields described in Table A2-1. The procedure of executing the various retrieval options will be explained in the following paragraphs by giving examples of the most common options used.

Permanent sort. The binary reference file /LIB.DATA may be permanently rearranged, if desired, by sorting on any of the data fields in Table A2-1. This type of sort may be both alphabetical and numerical, with the alphabetics given higher priority than numerics. The most obvious uses of this type of sort would be:

- Arrange references in order to increasing identification number
- Alphabetize references by authors
- Alphabetize references by title
- Arrange references in order of publishing date

An example of a permanent sort used to alphabetize by title is given below. The underlined characters represent typed input from the user, while the rest are written automatically by the computer.

```
SYSTEM:  C77/LIB.DATA

C77 SORT ON TITLE1,TITLE2!

OLE SET DATA.? YES

SORT COMPLETE.
```

3.0 (Continued)

```
    682 RECORDS READ FROM DAT.
    682 RECORDS SORTED TO DAT.
CC77 SYS
SYSTEM:
```

The above example will sort the references alphabetically by the TITLE1 and TITLE2 fields in Table A2-1. A sort on any other data field is made simply by inserting the name(s) of the field from Table A2-1 in place of TITLE1,TITLE2. Note that this procedure will sort the data permanently on the /LIB.DATA file (or until the next sort is made). If only a temporary sort is desired for the purpose of printing output, then an example described later should be used.

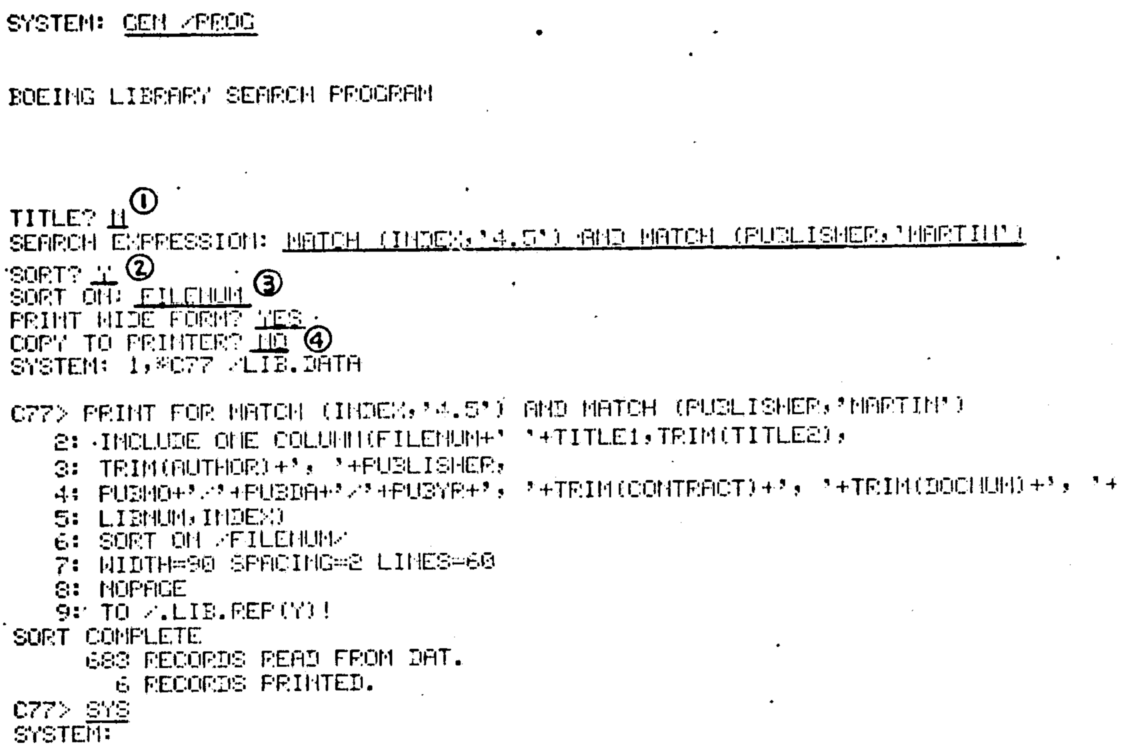
Normal reference retrieval. A program has been written to handle most types of information retrieval for the Crew Appliance Bibliography. The program will give two optional output formats (which may be easily changed): one is a complete, long form and the other an abbreviated form. A listing of this program is given in Figure A3-1. Sample output listings from this program for the long and short forms have been shown in Figure A1-2. Example cases showing how the program is executed, both for the long and the short output formats, are given in Figures A3-2 and A3-3. The underlined characters represent typed input required from the user, while the rest are written automatically by the computer. The comments written in the examples are self explanatory; and by following through them, one should

```
BOEING LIBRARY SEARCH PROGRAM


#CONFIRM <TITL> PROMPT 'TITLE'
#WHEN TITL
#ARG TITLE HELP 'ENTER TITLE STRING OR HIT CARRIAGE RETURN&
IF NO TITLE IS DESIRED'
#ENDWHEN
#ARG EXP PROMPT 'SEARCH EXPRESSION' HELP 'ENTER [FIELD] [LOGICAL OPERATOR] [VALU

  EXAMPLE. AUTHOR EQ "JOHNSON,L.B."'
#CONFIRM SORT
#WHEN SORT
#ARG SORTLIST PROMPT 'SORT ON'
#ENDWHEN
#CONFIRM WIDE PROMPT 'PRINT WIDE FORM'
#WRITE /.01
1,*C77 /LIB.DATA
PRINT FOR <EXP>
#WHEN WIDE
INCLUDE ONE COLUMN(FILENUM+' '+TITLE1,TRIM(TITLE2),
TRIM(AUTHOR)+', '+PUBLISHER,
PUBMO+'/'+PUBDA+'/'+PUBYR+', '+TRIM(CONTRACT)+', '+TRIM(DOCNUM)+', '+
LIBNUM,INDEX)
#WHEN SORT
SORT ON /<SORTLIST>/
#ENDWHEN
WIDTH=90 SPACING=2 LINES=60
#WHEN TITL
TITLE LEFT $<TITLE>$
REPEAT TITLE
#ENDWHEN
NOPAGE
#ELSE
INCLUDE LINE1=TRIM(TITLE1)+' '+TRIM(TITLE2)+', '+PUBMO+'/'+PUBYR+', '+
FILENUM "" (W 72)
#WHEN SORT
SORT ON/<SORTLIST>/
#ENDWHEN
WIDTH=80 NOPAGE SPACING=1
#WHEN TITL
   TITLE LEFT $<TITLE>$
#ENDWHEN
#ENDWHEN
TO /.LIB.REP(Y)!
SYS
#CONFIRM PRINT PROMPT 'COPY TO PRINTER'
#WHEN PRINT
COPY /.LIB.REP *P(F=14)
#ENDWHEN
#WRITE /.02-JO
OUT *T
#WHEN NOT PRINT
#ENDWHEN
**OUT *M
#JOB /.01
```

Figure A3-1. Library Search Program



```
SYSTEM: GEN /PROG

BOEING LIBRARY SEARCH PROGRAM


TITLE? N ①
SEARCH EXPRESSION: MATCH (INDEX,'4.5') AND MATCH (PUBLISHER,'MARTIN')
SORT? Y ②
SORT ON: FILENUM ③
PRINT WIDE FORM? YES
COPY TO PRINTER? NO ④
SYSTEM: 1,*C77 /LIB.DATA

C77> PRINT FOR MATCH (INDEX,'4.5') AND MATCH (PUBLISHER,'MARTIN')
   2: INCLUDE ONE COLUMN(FILENUM+' '+TITLE1,TRIM(TITLE2),
   3: TRIM(AUTHOR)+', '+PUBLISHER,
   4: PUBMO+'/'+PUBDA+'/'+PUBYR+', '+TRIM(CONTRACT)+', '+TRIM(DOCNUM)+', '+
   5: LIBNUM,INDEX)
   6: SORT ON /FILENUM/
   7: WIDTH=90 SPACING=2 LINES=60
   8: NOPAGE
   9: TO /.LIB.REP(Y)!
SORT COMPLETE
      683 RECORDS READ FROM DAT.
        6 RECORDS PRINTED.
C77> SYS
SYSTEM:
```

NOTE:

1. If response is Y, a title is asked for to be printed at top of each output page.

2. If response is N, the references will not be sorted, and output will be given in same order as references are stored.

3. Input here the desired data field from Table 4-1 for which references should be sorted.

4. If response is Y, the retrieved references will be printed on Com-Share printer at Ann Arbor, Michigan; otherwise they will not. In either case, retrieved and sorted references will be output to /LIB.REP File.

Figure A3-2. Example Bibliography Sort/Retrieval Computer Run Long Output Format

```
SYSTEM: GEN /PROG

BOEING LIBRARY SEARCH PROGRAM


TITLE? N ○
SEARCH EXPRESSION: MATCH (INDEX,'4.4') AND PUBYR EQ MOR('72','73','74')
SORT? N ○
PRINT WIDE FORM? N
COPY TO PRINTER? N ○
SYSTEM: 1,♦C77 /LIB.DATA

C77> PRINT FOR MATCH (INDEX,'4.4') AND PUBYR EQ MOR('72','73','74')
   2: INCLUDE LINE1=TRIM(TITLE1)+' '+TRIM(TITLE2)+', '+PUBMO+'/'+PUBYR+', '+
   3: FILENUM "" (W 72)
   4: WIDTH=80 NOPAGE SPACING=1
   5: TO /.LIB.REP(Y)!
     683 RECORDS READ FROM DAT.
       8 RECORDS PRINTED
C77> SYS
SYSTEM:
```

NOTE:

1. If response is Y, a title is asked for to be printed at top of each output page.
2. This response asks for references not to be sorted. They will be listed out in same order in which they are stored. See Figure A3-2 for example where sort is requested.
3. If response is Y, the retrieved references will be printed on Com-Share printer at Ann Arbor, Michigan; other wise they will not. In either case, retrieved and sorted references will be output to /.LIB/REP file.

Figure A3-3. Example Bibliography Sort/Retrieval Computer Run Short Output Format

3.0 (Continued)

be able to perform most of the data searches commonly required of the bibliography program. In the first example, all the reports pertaining to "Wash Water Processing" (index code 4.5 in Figure A1-1) which were written by Martin Marietta were retrieved, sorted in order by reference identification number, and printed out in the long format. In the second example, all the reports pertaining to "Laundry" (index code 4.4 in Figure A1-1) which were published after 1972 were retrieved and printed out in the short format.

SECTION 4

PART I - NUMERICAL REFERENCE LISTING

0001 - EUROPEAN SPACE RESEARCH ORGANIZATION SPACE SHUTTLE-SPACELAB DISCUSSIONS, , 04/17/73, NASA-JSC

0002 - SPACE SHUTTLE SYSTEM SUMMARY, ROCKWELL DOC. SSV73-45(R), 07/00/73, ROCKWELL

0003 - SPACE SHUTTLE SYSTEM TECHNICAL REVIEW, ROCKWELL DOC. SSV73-26, 04/16/73, ROCKWELL

0004 - SPACE SHUTTLE PROGRAM REVISED CABIN STUDY, ROCKWELL DOC. SSV73-13, 03/13/73, ROCKWELL

0005 - ORBITER VEHICLE END ITEM SPEC. FOR THE SPACE SHUTTLE SYS., PART 1, PERFORMANCE AND DESIGN REQUIREMENTS, SPEC. NO. MJ070-0001-1, 12/07/73,

0006 - SPACE SHUTTLE SYSTEM DEFINITION HANDBOOK, INTEGRATED VEHICLE CONFIGURATION 4, ROCKWELL DOC. SD72-SH-0068A, 07/23/73, ROCKWELL

0007 - ORBITER DEFINITION HANDBOOK VEHICLE CONFIGURATION 4, SD72-SH-0071A, 07/23/73, ROCKWELL

0008 - REQUIREMENTS-DEFINITION DOCUMENT ENVIRONMENTAL CONTROL AND LIFE SUPPORT BOOK 6, SD72-SH-0106, 01/31/74, ROCKWELL

0009 - MEMO, MINUTES OF THE JSC PAYLOADS COORDINATION MEETING #46 - FEBRUARY 25, 1974, , 03/01/74, NASA

0010 - MEMO, MINUTES OF JSC PAYLOADS COORDINATION MEETING #42- NOVEMBER 26, 1973, , 00/00/00, NASA

0011 - SPACE SHUTTLE SRR PAYLOAD ACCOMMODATIONS RID STATUS, , 11/01/73, NASA

0012 - SPACE SHUTTLE SRR PAYLOAD ACCOMMODATIONS RID STATUS AND RESULTS TO DATE, , 12/05/73, NASA

0013 - SPACE SHUTTLE AND SPACELAB DISCUSSIONS, JSC-09001, 03/22/74, NASA

0014 - SPACE SHUTTLE AND SPACELAB DISCUSSIONS-ROCKWELL PRESENTATION SPACE SHUTTLE OVERVIEW AND CURRENT STATUS, SSV73-58, 11/13/73, ROCKWELL

0015 - SPACE SHUTTLE AND SPACELAB DISCUSSIONS-VOLUME 8 ENVIRONMENTAL THERMAL CONTROL AND LIFE SUPPORT SYSTEM, JSC 08500, 10/12/73, NASA

0016 - SPACE SHUTTLE SORTIE PAYLOAD CREW SAFETY AND SYSTEMS COMPATIBILITY CRITERIA-VOLUME 1 EXECUTIVE SUMMARY, 22214-22215-H013-R0-00, 05/15/73, TRW

0017 - SPACE SHUTTLE SORTIE PAYLOAD CREW SAFETY AND SYSTEMS COMPATIBILITY CRITERIA-VOLUME 2 CREW SAFETY DESIGN & VERIFIC. CRITERIA, 22214-H014-R0-00, 05/15/73, TRW

0018 - SPACE SHUTTLE SORTIE PAYLOAD CREW SAFETY & SYS. COMPATIBILITY CRITERIA- VOLUME 3 SYSTEMS COMPATIBILITY DESIGN & VERIFICATION CRITERIA, 22215-H014-R0-00, 05/15/73, TRW

0019 - EUROPEAN SPACELAB PROGRAMME SUBSYSTEMS INTERFACES MEETING, , 10/11/73, ESRO-ESTEC-HEINZ STOEWER

0020 - SPACELAB PHASE B2 REPORT - VOLUME 2 PROGRAM DEFINITION, PART 1 EXECUTIVE SUMMARY, MBB REPORT NO. SL73-11, 06/29/73, MBB

0021 - SPACELAB PHASE 2B REPORT, VOLUME 2 PROGRAMME DEFINITION, PART 2 BASELINE PROGRAMME, MBB REPORT NO. SL73-12, 06/29/73, MBB

0022 - SPACELAB PHASE 2B REP, VOL 2 PROGRAMME DEF, PART 2 BASELINE PROGRAMME, APPENDIX BASELINE SYSTEM DESIGN SPECIFICATION, MBB REPORT NO. SL73-13, 06/29/73, MBB

0023 - ERNO-VFW-FOKKER PHASE 2B FINAL PRESENTATION TO ESRO-ESTEC-NASA, , 06/28/73, ERNO-VFW-FOKKER

0024 - ERNO-VFW-FOKKER SL-B2, VOLUME 2 PROGRAM DEFINITION, PART 1 EXECUTIVE SUMMARY, , 06/00/73, ERNO-VFW-FOKKER

0025 - ERNO-VFW-FOKKER SL-B2, VOLUME 2 PROGRAM DEFINITION, PART 2 BASELINE PROGRAM, , 06/28/73, ERNO-VFW-FOKKER

0026 - STATEMENT OF D R LORD DIR, SPACELAB PROG. NASA BEFORE THE MANNED SPACEFLIGHT SUBCOMM. OF THE COMM. ON SCIENCE & ASTRO. H OF REP, FY 75, , 03/05/74,

0027 - THE 1973 SPACE SHUTTLE TRAFFIC MODEL, TMX-64751, 07/00/73, NASA-MSFC

0028 - STUDY OF SHUTTLE-COMPATIBLE ADVANCED TECHNOLOGY LABORATORY (ATL), NASA TMX-2813, 09/00/73, NASA-LANGLEY

0029 - MODULAR SPACE STATION DETAILED PRELIMINARY DESIGN VOLUME 1, SECTIONS 1 THRU 4.4, MDAC DOC NO. MDC G2582, 11/00/71, MC DONNELL DOUGLAS

0030 - MODULAR SPACE STATION DETAILED PRELIMINARY DESIGN VOLUME 2, SECTIONS 4.5 THRU 4.8, MDAC DOC. NO. MDC G2582, 11/00/71, MC DONNELL DOUGLAS

0031 - SHUTTLE ECLS PAYLOAD PENALTY FOR MISSIONS WITH LARGER CREWS & EXTENDED DURATION, MSC 06941, 12/11/72, NASA-JSC

0032 - SPACE SHUTTLE SYSTEM BASELINE REFERENCE MISSION VOLUME 2-REVISED MISSION 2, MSC 07896, 08/17/73, NASA-JSC

0033 - FUNCTIONAL REQUIREMENTS FOR ONBOARD MANAGEMENT OF SPACE SHUTTLE CONSUMABLES VOLUME 1-FINAL REPORT, TRW REP. 22104-H001-R0-00, 11/16/73, TRW

0034 - FUNCTIONAL REQUIREMENTS FOR ONBOARD MANAGEMENT OF SPACE SHUTTLE CONSUMABLES VOLUME 2-FINAL REPORT, TRW REP. NO. 22104-H002-R0-00, 11/16/73, TRW

0035 - SPACE SHUTTLE ENVIRONMENTAL & THERMAL CONTROL- LIFE SUPPORT SYSTEM STUDY-FINAL REPORT, AIRESEARCH REP. NO. 73-9097, 03/14/73, AIRESEARCH

0036 - EC-LSS THERMAL CONTROL SYSTEM STUDY FOR THE SPACE SHUTTLE-INTERIM REPORT, VOUGHT REP. NO. T201-RP-20001, 12/06/72, VOUGHT MISSILES & SPACE CO

0037 - HABITABILITY STUDY SHUTTLE ORBITER-FINAL REPORT, , 12/00/72, RAYMOND LOEWY-WILLIAM SNAITH, INC

0038 - HABITABILITY STUDY SHUTTLE ORBITER- CONTRACT SUMMARY REPORT, , 12/00/72, RAYMOND LOEWY-WILLIAM SNAITH, INC

0039 - SPACE STATION PROTOTYPE INTERIM SYSTEM PERFORMANCE SPECIFICATION, HSD DOC. NO. 15, 06/19/70, HAM-STAND.

0040 - SSP PHASE 2A REVIEW (MINUTES, SLIDES, & COMMENT), , 07/02/72, HAM-STAND.

0041 - SSP ETC-LSS PRELIMINARY DESIGN REVIEW (MINUTES, SLIDES, & COMMENT DISPOSITION), , 01/15/71, HAM-STAND.

0042 - SSP PRELIMINARY SYSTEM PERFORMANCE SPECIFICATION & CONFIGURATION DEFINITION, DOC. NO. 5, 02/06/70, HAM-STAND.

0043 - SSP PRELIMINARY SYSTEM CONFIGURATION DEFINITION-SYSTEM INSTALLATION DATA, SSP DOC. NO. 4, 01/19/70, HAM-STAND.

0044 - SSP REQUIREMENTS AND CONSTRAINTS, REV. B, SSP DOC. NO. 8, 08/24/70, HAM-STAND.

0045 = SSP FINAL REPORT, SSP DOC. NO. 165, 10/00/73, HAM-STAND.

0046 = SSP EXPERIENCE REPORT, SSP DOC. NO. 166, 10/00/73, HAM-STAND.

0047 = SSP AR GROUP PRETEST PERFORMANCE, SSP DOC. NO. 79, 06/18/73, HAM-STAND.

0048 = ARCHITECTURAL AND ENVIRONMENTAL CONSIDERATIONS FOR SPACE STATION DESIGN, NASA DOC MSC 04777, 06/00/71, NASA-JSC

0049 = MODULAR SPACE STATION SYSTEM REQUIREMENTS HANDBOOK, REV. A, ROCKWELL DOC. SD71-205, 03/22/71, ROCKWELL

0050 = HANDBOOK OF PILOT OPERATIONAL EQUIPMENT FOR MANNED SPACEFLIGHT, NASA MSC 07210, 06/16/72, NASA-JSC

0051 = SKYLAB PROVIDES HABITABILITY GUIDELINES, , 04/08/74, AVIATION WEEK

0052 = CONT. END ITEM DETAIL SPEC. (PRIME EQUIP) PART 1 & 2 PERFORMANCE-DESIGN & PRODUCT CONFIG. REQT'S FOR SKYLAB PERSONNEL HYGIENE EQUIP., NASA MSC 01486, 11/15/71, NASA-JSC

0053 = FAMILIARIZATION MANUAL FOR SKYLAB 28-DAY CLOTHING MODULE AND CONTINGENCY CLOTHING MODULE, NASA MSC 04602, 07/31/72, NASA-JSC

0054 = FINAL REPORT OF A STUDY OF CREW FUNCTIONS & VEHICLE HABITABILITY REQT'S FOR LONG-DURATION MANNED SPACEFLIGHTS, VOL. 1 SUMMARY REPORT, , 08/00/65, SERENDIPITY ASSOCIATES

0055 = STUDY OF CREW FUNCTIONS & VEHICLE HABITABILITY REQT'S. FOR LONG-DURATION MANNED SPACEFLIGHTS, VOLUME 1 TECHNICAL REPORT, , 05/00/65, SERENDIPITY ASSOCIATES

0056 = STUDY OF CREW FUNCTIONS & VEHICLE HABITABILITY REQT'S. FOR LONG-DURATION MANNED SPACEFLIGHTS, VOLUME 2 TECHNICAL APPENDICES, , 05/00/65, SERENDIPITY ASSOCIATES

0057 = FINAL REPORT OF A STUDY OF CREW FUNCTIONS & VEHICLE HABITABILITY REQT'S FOR LONG-DURATION MANNED SPACEFLIGHTS, VOL. 2 TECHNICAL PROGRAM, , 08/00/65, SERENDIPITY ASSOCIATES

0058 = FINAL REPORT OF A STUDY OF CREW FUNCTIONS & VEHICLE HABITABILITY REQT'S FOR LONG-DURATION MANNED SPACEFLIGHTS, VOL. 3 TECHNICAL APPENDICES, , 08/00/65, SERENDIPITY ASSOCIATES

0059 = SYSTEMS REQUIREMENT BOOK (SRB) SPACE STATION B NUCLEAR REACTOR-BRAYTON-NR-B, SD70-507, REV. B, 10/20/70, ROCKWELL

ORIGINAL PAGE IS
OF POOR QUALITY

0060 - SKYLAB FOOD TEST AND INTEGRATION, FINAL REPORT, , 01/31/73, TECHNOLOGY INCORPORATED

0061 - FROZEN COMPONENT MEALS PACKAGED FOR MEDICAL FOOD SERVICE, SAM-TR-70-66, 12/00/70, USAF SCHOOL OF AEROSPACE MEDICINE

0062 - LIFE SUPPORT REQUIREMENTS FOR THE SECOND DECADE OF MANNED SPACEFLIGHT, , 00/00/70, LOCKHEED MISSILES & SPACE CO.

0063 - FOOD, WATER, AND WASTE IN SPACE CABINS, AEROSPACE MED., ACC. NO. RC1062ARS, 00/00/71, AEROSPACE MEDICINE SECOND EDITION

0064 - MAN IN SPACE, SPACE RES. & TECH. ACC. NO. TL1500S6, 00/00/69, SPACE RESEARCH & TECHNOLOGY, VOL. 1

0065 - FEEDING MAN IN SPACE, ACC. NO. TL500W8 1969, 06/18/70, TL500W8 1969

0066 - SPACECRAFT HOUSEKEEPING AND ITS RELATIONSHIPS TO LOGISTICS, ACC. NO. TL3000.A1, 04/23/71, PROC. 8TH SPACE CONGRESS, VOL. 1

0067 - AN INTRODUCTION TO THE WASTE MANAGEMENT PROBLEM FOR LARGE SPACE STATIONS, ACC. NO. TL787S67, 06/24/70, ROCKWELL-ASME

0068 - WATER RECOVERY BY VAPOR PYROLYSIS, ACC. NO. TL787S67, 06/24/70, GE-ROCKWELL-ASME

0069 - THE PROCESSING OF HUMAN WASTES BY WET OXIDATION FOR MANNED SPACECRAFT, ACC. NO. TL787S67, 06/24/70, LSMC-NASA-LANGLEY-ASME

0070 - HOUSEKEEPING CONCEPTS FOR MANNED SPACE SYSTEMS, FINAL REPORT, MS124Y0003, 10/30/70, FAIRCHILD HILLER

0071 - ASTRONAUT ZERO GRAVITY PERFORMANCE EVALUATION PROGRAM- FINAL STUDY REPORT, VOLUME 2, DETAILED TECHNICAL REPORT, , 11/04/70, GENERAL ELECTRIC

0072 - FOOD HEATING-SERVING TRAYS- QUALIFICATION TEST REPORT, WHIRLPOOL REP. 24-00917, 05/11/72, WHIRLPOOL

0073 - HOUSEKEEPING CONCEPTS FOR MANNED SPACE SYSTEMS-EXECUTIVE SUMMARY REPORT, MSC 01251, MS124Y0004, 10/30/70, FAIRCHILD-HILLER

0074 - PYROLYSIS OF SPACE BASE WASTES, MSC 05111, 10/29/71, NASA-JSC

0075 - TEST REPORT-TWO STAGE WASTE MANAGEMENT SYSTEM, SSP DOC. NO. 63, 04/10/73, HAMILTON STANDARD

0076 - GAS ANALYZER- FINAL REPORT, BECKMAN DOC NO FR-1067-101, 09/29/70, BECKMAN INSTRUMENTS, INC.

0077 - ZERO GRAVITY RIGID CAN HANDLING, , 08/14/70, WHIRLPOOL CORPORATION

0078 - SPACE SHUTTLE TECHNOLOGY CONFERENCE, VOLUME 2-BIOTECHNOLOGY, TL 789.8 .U5 A12, TR-1114, 03/18/71, AIAA-NASA

0079 - SUBSYSTEM TRADE-OFF ENVIRONMENTAL CONTROL AND LIFE SUPPORT FOR ORBITER PHASE B CONTRACTOR, TL 789.8 .U5 A12, TR-1114, 03/18/71, AIAA-NASA

0080 - WATER MANAGEMENT FOR EXTENDED-DURATION MANNED SPACE MISSIONS, NASA SP-205, 39573, 00/00/71, DOUGLAS AIRCRAFT CO.

0081 - AEROSPACE FOOD TECHNOLOGY, NASA SP-202, 36876, TX 361.A8 C75, 04/17/69, NASA

0082 - PRESERVATION OF URINE IN A SYSTEM FOR REGENERATION OF WATER FROM IT, NASA TT F-719, 00/00/71, ACADEMY OF SCIENCES OF THE USSR

0083 - PROBLEMS OF SPACE BIOLOGY, VOLUME 16, NASA TT F-719, 00/00/71, ACADEMY OF SCIENCES OF THE USSR

0084 - SUPPORT OF ZERO GRAVITY FOOD HANDLING TESTS, , 07/07/70, WHIRLPOOL CORPORATION

0085 - APOLLO SPACECRAFT INFLIGHT HOUSEKEEPING, MSC 03206, 10/13/70, NASA JSC

0086 - MATRIX CRS RECONCILIATION:OFF-DUTY ACTIVITIES EQUIPMENT, MSC 05307-33, 06/09/72, MARTIN MARIETTA

0087 - MATRIX CRS RECONCILIATION:HEATING FOOD TRAY, MSC 05307-47, 08/01/72, MARTIN MARIETTA

0088 - MAN, HIS ENVIRONMENT, AND MICROBIOLOGICAL PROBLEMS OF LONG-TERM SPACEFLIGHT, NASA SP-205, 39573, 08/18/67, NASA LANGLEY

0089 - LIFE SUPPORT SYSTEMS INTEGRATION, NASA SP-205, 39573, 08/18/67, NASA LANGLEY

0090 - CLOTHES AND DISHWASHER-DRYER CONCEPT STUDY-TASK 1 INFORMAL REPORT , MCR-72-109, 04/00/72, MARTIN MARIETTA CORP-HSD

0091 - ZERO GRAVITY CLOTHES WASHER, , 02/00/71, WHIRLPOOL

0092 - FOOD SYSTEM FINAL REPORT FOR SPACE SHUTTLE, G.E. TIR 720-S-0008, 05/14/71, GENERAL ELECTRIC

0093 - DEVELOPMENT OF A PROTOTYPE WASTE COLLECTION SYSTEM (THE MODIFIED HYDROJOHN), G.E. 71SD5211, 03/31/71, GENERAL ELECTRIC

0094 - AN EVALUATION OF THE EXER-GENIE EXERCISOR & THE COLLINS PEDAL MODE ERGOMETER FOR DEVELOPING PHYSICAL FITNESS-FINAL PROGRESS REPORT, , 08/31/73, HARDING COLLEGE

0095 - WASH WATER RECOVERY SYSTEM, 73-9497, 10/10/73, AIRESEARCH MFG CO

0096 - FAMILIARIZATION MANUAL FOR THE SKYLAB OFF-DUTY ACTIVITIES EQUIPMENT, MSC 04636, CSD-S-062, 02/03/72, NASA JSC

0097 - FAMILIARIZATION MANUAL FOR THE SKYLAB PERSONAL HYGIENE KITS, MSC 04629, CSD-S-055, 11/15/71, NASA JSC

0098 - PREDELIVERY ACCEPTANCE TEST PROCEDURES FOR THE INCUBATOR-WORK STATION ASSEMBLY-INFLIGHT MEDICAL SUPPORT SYSTEM FOR THE SKYLAB PROGRAM, MSC 04514, 10/04/72, NASA JSC

0099 - PREDELIVERY ACCEPTANCE TEST PROCEDURES-DENTAL KIT-INFLIGHT MEDICAL SUPPORT SYSTEM FOR THE SKYLAB PROGRAM, MSC 04502, 09/28/72, NASA JSC

0100 - TRADE-OFF STUDY & CONCEPTUAL DESIGNS OF REGENERATIVE ADVANCED INTEGRATED LIFE SUPPORT SYSTEMS (AILSS), NASA CR-1458, 70N24951, 01/00/70, NASA

0101 - WASTE CONTROL, ACC. NO. TL521.3.C.6 A3 1458, 01/00/70, NASA

0102 - WATER MANAGEMENT, ACC. NO. TL521.3.C.6 A3 1458, 01/00/70, NASA

0103 - CREW PROVISIONS, ACC. NO. TL521.3.C.6 A3 1458, 01/00/70, NASA

0104 - PRELIMINARY RESULTS FROM AN OPERATIONAL 90-DAY MANNED TEST OF A REGENERATIVE LIFE SUPPORT SYSTEM, NASA SP-261, 11/18/70, NASA-LANGLEY

0105 - HABIT- ABILITY, SP-261, 11/18/70, NASA-LANGLEY

0106 - FOOD MANAGEMENT PROGRAM, SP-261, 11/18/70, NASA-LANGLEY

0107 - DESIGN & OPERATION OF A WASTE MANAGEMENT SYSTEM FOR FECAL COLLECTION AND SAMPLING DURING THE 90-DAY MANNED SIMULATOR TEST, SP-261, 11/18/70, NASA-LANGLEY

0108 - FEEDING MAN IN A CLOSED ECOLOGICAL SYSTEM, ACC. NO. T176T68 NO. 1, 00/00/67, WHIRLPOOL CORPORATION

0109 - WATER RECLAMATION AND CONSERVATION IN A CLOSED ECOLOGICAL SYSTEM, ACC. NO. T176T68 NO. 1, 00/00/69, NASA-LANGLEY

0110 - RECENT ADVANCES IN CLOSED LIFE SUPPORT SYSTEM CONCEPTS, , 06/00/69, NASA-AMES

0111 - GRAVITY-INDEPENDENT LIQUID COLLECTION AND FLUID PHASE-SEPARATION SYSTEM, , 06/00/69, MARTIN MARIETTA

0112 - MICROBIOLOGICAL STUDIES ON A WATER MANAGEMENT SUBSYSTEM FOR MANNED SPACEFLIGHT, , 10/00/68, NASA-LANGLEY

0113 - WET OXIDATION FOR SPACE WASTE MANAGEMENT, , 10/00/68, GENERAL ELECTRIC

0114 - WATER AND WASTE MANAGEMENT SYSTEMS, ACC. NO. N72-71553-N72-71590, 00/00/65, NASA

0115 - INTEGRATED REGENERATIVE LIFE SUPPORT SYSTEM, ACC. NO. N72-71553-N72-71590, 00/00/65, NASA

0116 - SEARCH FOR PREPARATIONS FOR PRESERVATION OF FECES FOR USE UNDER SPACEFLIGHT CONDITIONS, , 05/00/69,

0117 - ASTRONAUTS' BASIC REQUIREMENTS FOR PERSONAL HYGIENE MATERIALS, , 05/00/69,

0118 - FABRICATION OF MOCKUPS OF FOOD HEATING-SERVING TRAYS FOR CREW COMPARTMENT STOWAGE REVIEWS-FINAL REPORT, , 07/00/71, WHIRLPOOL

0119 - PREDELIVERY ACCEPTANCE TEST PROCEDURES-DIAGNOSTIC KIT-INFLIGHT MEDICAL SUPPORT SYSTEM FOR THE SKYLAB PROGRAM, MSC 04507 REV. C, 12/16/72, NASA-JSC

0120 - PREDELIVERY ACCEPTANCE TEST PROCEDURES-BANDAGE KIT-INFLIGHT MEDICAL SUPPORT SYSTEM FOR THE SKYLAB PROGRAM, MSC 04510, 06/29/72, NASA-JSC

0121 - PREDELIVERY ACCEPTANCE TEST PROCEDURES-MINOR SURGERY KIT-INFLIGHT MEDICAL SUPPORT SYSTEM FOR THE SKYLAB PROGRAM, MSC 04504, 06/07/72, NASA-JSC

0122 - COMFORT EVALUATION OF PROTOTYPE HYDROJOHN-FINAL REPORT, MSC 01368, CSD-A-1087, 11/12/70, NASA-JSC

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J G CARL, J T WAGGONER, W J BEITTEL, GENERAL ELECTRIC
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A J GIOTTA, FAIRCHILD

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BERT COOPER, FAIRCHILD HILLER
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R M BYKE, R V GRECO, A PISCIOTTA, JR, DOUGLAS AIRCRAFT CO, INC
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D F PUTNAM, G W WELLS, K H HOUGHTON, MC DONNELL DOUGLAS
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ANON, ACOUSTICA ASSOCIATES
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R B JAGOW AND R W JOY, LOCKHEED
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ANON, NASA-JSC
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A W JORDAN, T H PURCELL, JR, ESB, INC
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K C JONES, J E SWIDER, H BROSE, HAMILTON STANDARD
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D AMORELLI, J T CELENTANO, ROCKWELL

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E A SCHUMACHER, MARTIN MARIETTA
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W J MARTIN AND C W ROHWEDDER, WHIRLPOOL
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J K MAGGIALARDI, R W MURRAY, GENERAL ELECTRIC
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ANON, OAK RIDGE NATL LAB
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F F DOPPELT, SCH OF AEROSPACE MEDICINE

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M BELLO, AEROSPACE CORP
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G E LAUBACH, G C SCHAEDLE, ROCKWELL
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W WOKOUN AND J D WEISZ, U S ARMY HUMAN ENGINEERING LABS
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V I VASHKOV, A G PRISHCHEP, 7TH INTERNATL SP SCIENCE SYM
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J E VANDERVEEN AND T H ALLEN, COSPAR
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G WYLLIE, PROC ROY SOC
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E A SCHUMACHER, MARTIN MARIETTA-HSD
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G BOSWINKLE AND N G ROTH, WHIRLPOOL CORP
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L E ROVENSTEIN AND D K CHAFFEY, MARTIN MARIETTA
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J B HALL, NASA-LANGLEY
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ANON, NASA-JSC
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J R JAAX,
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L N ROGA AINA, A M KARAGODINA, V A PANCHENKO, ACADEMY OF SCIENCES OF THE USSR
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